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PHILOSOPHY.

ABOUT LIFE AND LIFE THEORIES.

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The objective of all knowledge and philosophy, of all research and dogma, of all speculation and theory, is the one problem: Whence are we? He who defines God for us, they who supply gods in pantheons for us, even he who denies all gods or any God, is asking the same question and answering it in his way. It is the one irrepressible inquiry of man in all time, the one mystery that has been plucked at by all humanity. But the secret remains inscrutable as in the beginning. Authority has assumed to answer it, theology has essayed to teach it, revelation has been conjured to authenticate it, and the sword has been invoked to settle it. But the question is still asked. Finally, science has attempted to investigate it, but the oracle has not responded. Over it still hangs the infinite mystery, deepening only as we detect a footprint here and there, and growing in wonder and awe as we approach its ultimate manifestations, or as we draw nearer the portals within which is its habitation.

It is not the purpose of this paper to enter the debate—only to present, as it may, the present state of the question; or, rather, to inquire as to the progress of the discussion, and to note how far investigation is agreed, and to mark the diverging points from the common path.

It would be uncandid, however, were the statement omitted that it is

granted, as a starting-point, that the burden of proof is not on both sides alike. Certainly the original, and, it may be said, the universal inspiration and impulse of humanity are entitled to the affirmative of the question. That affirmative is that life is the result of a creative power or of an intelligent purpose. This is so all-pervading and instinctive as to have been accepted without the processes of reason or the conscious use of that faculty of the mind—and we define it by another word—faith. In fact, we may class it among the moral, as we do the organs of involuntary action among the physical attributes of our being. It is, then, but fair, but reasonable, but philosophic and scientific that this must be set aside, if at all, by the most unanswerable facts.

It may be as well here to state that, so far as authority is concerned, or where a fact of scientific character is stated, it will be from a source recognized by the scientific world and of the latest accessible. And where there is a dispute, both sides will be given. Haeckel, Huxley, Darwin, Tyndall, Beale and others are laid under contribution. But it has been thought best not to cumber the recital by mere repetition of names which add nothing to the force of the argument, but often break the thread of connected statement. The data are all borrowed, and it is only the conclusions or the hypotheses, as the case may be, for which this paper is responsible.

The two theories stand face to face with each other; some call them the spiritual and the material. High authority classes them respectively as religion and science, while hypothesis treats them as creation and evolution. The first idea under all forms of designation demands a power above matter as the cause of life. The second requires, as its indispensable premise, spontaneous generation through the forms and action of matter, the result of which is life. The one requires matter controlled so as to produce the phenomena of life, or vitalized by a supra-material force; the other demands life as from the action of matter obeying its own inherent laws.

This recital, it is hoped, will serve as a fair, if not a scientific definition, and enable us to follow the argument without confusion. It is necessary to fix these radical distinctions in the mind before entering upon the subject, as, when the results of investigation into the ultimate forms of matter and the primitive movements which attend it in connection with the living are considered, the line of separation becomes so involved as to require the constant recognition of this fundamental difference, for both hypotheses deal with the same methods, the same objects, and invoke the same aids. There is but the one road to the same end. The question is not what is the object reached, but how it came there, and by what power it is there?

The hypothesis of evolution demands spontaneous generation as its logical beginning, for its whole theory of development as a law of living things, operating by natural selection and the survival of the fittest, does not even admit of variety or of species, as this at once destroys its consistency. Neither does it admit of an antecedent period, when spontaneous generation was prolific and the different forms of living things were born in the germ, for that would be creation,

and the consequences only growth. And this is all we are asked to believe by the other hypothesis. The fact of life must, then, be found in a beginning from the operation of a law of matter, or from some inhering quality of matter itself. This quality is called force, but that is merely the name given to a supposed potential agent that has not been seen or felt, or even presented to the tangible recognition of the intellect. It is itself a hypothesis.

If this is declined as the basis upon which evolution must rest, there is but one other alternative left—that there was no beginning. And this assumes the immortality of matter itself in the forms in which it is manifest to us. Later on, when we reach the point of speculation, this may be considered, but it has no place here with the two theories under consideration. A theory of which development is the essence cannot take refuge behind a defense which destroys its primal order.

Investigation into the basis of life has been confined in science to the period covered by the microscope, and as its results are uniform in the hands of the observer, be he the believer in one or the other theory, it is only by the light they throw upon the mind, and its point of interpretation, that we reach a conclusion. And it must be admitted that names equally high in authority as investigators differ as to the hypotheses to be drawn from a mutually-admitted state of facts disclosed by the microscope. It is, then, in the careful discrimination of facts and their phenomena, or the looser habit of assuming or of generalization, as distinguished from careful detail, that the weight of evidence is to be determined. For example, the ultimate forms of life must, for purposes of description or explanation, have a name. These are known and spoken of as atoms, molecules, moners, protoplasm, bioplasm—or, specifically, protoplast and bioplast are most commonly used. Protoplast means "first form;" bioplast, "life form;" and in their definition is conveyed the radical difference between the two ideas or theories. It is, then, necessary to be exact in the use of terms, otherwise there is confusion. We cannot in this connection use atom, because it is purely a thing of hypothetical or mathematical existence—it is not microscopic. Molecule is too indefinite for the discussion, as it means only a "little mass." And if we use protoplast, we concede one element of the dispute; and if we use bioplast, we assume a controverted point. It is best, then, to employ the term *matter*, and define its quality by the proper adjective when used, bearing in mind that always when referring to the ultimate forms of matter, as known, it is to microscopic substances.

This ultimate mass, in the hands of Haeckel of the one school, or of Beale of the other, is exactly the same formless, unorganized, colorless particle. It has, however, specific functions, and it is these functions that constitute the point of divergence. According to the school of evolution, the origin of life is the result of combined action of supposed forces inherent in this ultimate mass, and that these forces sustain this result of their combined action. These forces are supposed to be what we call heat, light, electricity, motion, etc. And not only this, but these combined forces enlarge the result by endowing it with indefinite

growth and unlimited variety in development. And still farther, these forces, we are told, are but the modifications of one all-potent and universal force.

We are told, too, in logic, that this force has endowed this result of its combined action with varied properties, by which future spontaneous generation will be rendered unnecessary by investing this primordial germ with the sexual function, from which all life to follow must originate. For the underlying hypothesis of evolution is that this result of the combined action of these forces took place at some inconceivably anterior date, and when the conditions were in fortuitous and incomprehensible conjunction, and that it has been impossible since; that from this remote period we date all life, be it vegetable or animal. This is not overstating the hypothesis—it is not as forcible or as clear as would have been literal quotation.

It must be confessed that this taxes credulity in one direction as far as the dogma of a special and contemporaneous creation does in another. Is it not traveling in the same circle and calling the same things by different names?

This primordial germ of life, we are told, is not hypothetical, but has a locality and a name, and no one need be at a loss where to look for it. It has been discovered in an ooze that is found at the bottom of the sea at great depths. In this ooze has been detected these masses of what this school calls *protoplasm*, or "first forms"—these structureless, colorless masses of matter which have life in them. And because these have been found here, *ergo*, here is the secret of all time wrenched from the eternal keeping of old Ocean by the sounding apparatus of a telegraph cable ship. It is not proper to treat so grave a topic with levity, nor is it in that spirit that we make the comparison, but, speaking gravely and reverently, where is the essential difference? Moses says: "Man was formed of the dust of the ground." Haeckel says: "Man has come from the ooze of the sea." The one employs material that may or may not have been dry; the other uses that which from necessity must derive all life from that of the waters.

But if this ooze contains the original, primordial, spontaneously-generated life, why does not the act of production proceed with the same force and prolific power as was once its property? Surely this now living ooze was not itself born at the inconceivably remote period that evolution assigns to life, and remained in this primordial state ever since, incapable of growth or development. The same influences that by their withdrawal left life only with the power of extending by procreation, must have killed this form of life if they did not endow it with the energy of increase. It could not have once had the power to grow and be denied it now. This is the very negation of law; and a law of nature can neither die nor be suspended—its essence is its eternity. If we are to accept this, let us not laugh when told that the sun stood still on Gibeon, and that the moon rested in her course over the valley of Ajalon. It cannot have been potential in the past and inert now, and, if born in the recent, it cannot have been primordial. But it furnishes no form of life that can be recognized as traveling any of the intermediate stages of evolution between the first and the last manifestation. It cannot be assigned to the position chosen for it by any known law of growth, or by any

observed phenomena of existing life. If we must accept it, it is because scientific authority on other subjects says that it is what it is. Or, changing the form of expression again, it is "thus says Haeckel," for "thus saith the Lord," "And Haeckel saw the ooze and it was good"—is all the authority we have for it.

True, Sir Wyville Thompson, one of the first discoverers of this ooze, now says he was in error, and that in all his soundings with the *Challenger*, over a period of three years, he failed to find it; yet Haeckel tells us that Emil Bessels, while on the *Polaris*, found it at the bottom of the Northern Seas. So we must admit that, if it does not overspread the bottom of the deep and warm seas of the globe, it is found in the colder seas of this hemisphere. But is it not more rational to accept what other eminent microscopists who have examined this ooze assert that, instead of being a mass of living matter, which grows at the expense of inorganic elements, it is a mass of slime, with many foreign bodies in it, and the debris of living organisms that have passed away, but having numerous living forms still in it?

When, then, we find the advocates of the evolution theory agreed that spontaneous generation is not now possible under existing forms, and find those of equal authority agreeing that this supposed source of life is only a form of existing life, with the one only claimant in favor of it being the primordial state of life, are we not justified in taking the hypothesis as at least not proved, and that we must look for the origin of life in another direction? Is this unreasonable? Is it not demanded?

But what does the physical investigator have for us in this direction? Let us now lay aside hypothesis for awhile and see what the living organism has for the eye. In the lower organisms, in plants as well as the human brain, it is the same and may be studied. Living matter in all living things is in appearance the same—"always transparent, colorless, and without structure." It is the same in the germ in the womb as in the octogenarian the moment before he ceases to live. It never changes its character, never loses its distinctive appearance, never ceases its activity. It has the power of absorbing or taking up other substance and imparting its own quality to it, but is never appropriated by any other substance or changed into it. It has the power of multiplication indefinitely, but only changes its own state by dying. It is born and it dies, but has no development. It forms all known qualities of organic matter, but is without form or consistence itself.

This which will be described as living matter is the agent of all growth. It begins in the germ and pushes itself forward in what we call growth. It moves of its own accord, passing from contact with formed matter, which it takes up and leaves behind it as structure. That it is not pushed by an unseen force in such a case is shown by the fact that in another it pushes — as in the formation of a hair, where the tube is formed at the root and pushed out—the exact reverse of the tissue-forming process. That it is not confined in forming living organism by the process of depositing in one case and pushing in another is shown in its formation of that wonderful thing in the living structure, a nerve, which it spins

as a spider spins its web—that is, it runs ahead at differing distances, drawing out the nerve thread from the mass of material with which it works.

Here we have three actions or functions, and not one of them in obedience to any known law of matter or of the physical world. All are in direct opposition to the law of gravity, neither conforms to any function of chemistry. Not only has it the power to do all these, but it has that to separate and divide itself, and one particle move away from another, or in advance of another, or over or under another, and be performing, so to speak, two or more tasks, or two or more kinds of work at the same time.

We were told in a very interesting paper read at our last meeting in the summer that there was no mystery about this peculiar thing which is called "bioplast," as there was "a muscle, a bone, a skin and a brain bioplast," and so for every part of the living organism. But this is not demonstrable. So far as can be known, there is but the one for not only all structure in the living organism, but for all life. The same inscrutable mass that makes the finger-nail builds up the brain, and the gray matter of that organ is composed of and formed by precisely the same agent that forms the foot. "The living matter of all organisms, and of the tissues and organs of each organism, exhibits precisely the same characters. It lives, and grows, and forms in the same way, although the conditions under which the phenomena of life, growth and formation are carried on differ very much in different kinds of germinal matter." This difference of kind, however, is only known from the fact that some matter will live in states of temperature in which others will die, while matter that will be appropriated by it in some instances will act as a poison in others. While these masses of living matter show no difference in appearance, the only conclusion to be drawn from the fact is that it must be from difference in inherited power. It cannot be from any physical or chemical properties, else we could ascertain it by examination. It is a property that cannot be isolated. We only know that the action in all is the same in every respect. If all matter with life was from this ooze, this difference could not be.

But, then, we are told that all this is from the action of forces, or the inherent force of matter. One of the confusing things in the discussion of exact problems is the improper use of words. And no word is more abused than this one of force. We are told of the force of matter, of the power of matter, and of the properties of matter—all being applied indiscriminately to the same phenomena. There is a wide difference. Power is capable of action, and can do things according to design—can arrange or construct. Property belongs to material things, is passive, and can no more be destroyed than the thing itself. But force may be changed, however, as to form, mode or condition; may assume varied forms and be re-converted into its original one. And all matter might be reduced to chaos again, yet power, property and force exist precisely as now. But in the order of life there is a faculty, which neither force, nor power, nor property can produce or explain, and it will not answer simply to ignore it, or to say it is to be accounted for by some quality not yet discovered. It must be remembered that

"assumption" is the very essence of the objection of the materialist to the system he combats, and if the problem cannot be solved by assumed premises on the one hand, it cannot be overthrown by assumption on the other. We know that living matter displays phenomena and functions which no property of matter from any known process of investigation has been able to explain.

But let us see how this substance that makes all living organism does its work. We shall not follow it from the ovum into the living being, as that is familiar to the student of both theories, and there is no dissent as to the facts. We will see how it works in the processes of growth. First, however, to show the extent of the position held on this subject, let me quote a comprehensive sentence from the concededly highest authority among English-speaking men on evolution. He says: "The whole world, living and non-living, has resulted from the mutual action and non-action of the forces possessed by the molecules of which the primitive nebulosity of the universe was composed." And then follows this sweeping declaration: "It is no less certain that the existing world lay, potentially, in the cosmic vapor, and that a sufficient intelligence could, from a knowledge of the properties of the molecules of that vapor, have predicted, say, the state of the fauna of Britain at this day with as much certainty as we can say what will happen to the vapor of breath in a cold winter day."

How a robust intellect, as is that which uttered this, can after that deny to a "sufficient intelligence" the power, and function and exercise of "foreknowledge," "predestination" and "eternal and unchanging decree" passes understanding. And how it differs from the most unqualified dogmas of theology cannot be detected in essence. It is arriving by a negative at the starting-point of the circle to which the advocates of the other hypothesis arrive by affirmation. It is substituting one kind of creation by another, and, while denying the agency of a personal supernatural power, invests itself with not only the elements of immortality, but with the plan and will of infinite knowledge, power and purpose. But if this is so, and matter has these essential properties, which in proper combinations or conditions must produce life, how comes it that, in all the years of experiment, the combined efforts of the highest skill have failed to produce the smallest, the most rudimentary of living things—have failed to make even a molecule pulsate with life? And is it possible that in the very penetralia of science so broad and sweeping a declaration has no basis but the brilliant imagination of a devotee of demonstrated facts upon which to rest?

But here we come to another assumption, and it is worthy of remark how these champions of "facts" assume so many things which have no known fact to rest upon. While it is admitted that there is no discovered fact to controvert what has been affirmed as to the structureless nature of living matter, and the phenomena of its action, yet we are told this, by another of the most eminent names in science: "That between the microscope limit and the true molecular limit there is room for infinite permutations and combinations." Has it not occurred that if the microscope is to be thrust out of this discussion, the entire system of physical investigation into the origin of life falls with it; or, in other

words, if you must seek a solution outside ascertained fact, the very citadel so long held against dogma must be surrendered? If we let go the inductive system, where is the difference between the assertion of Dean Huxley and Dean Doctrine? If this microscopic mass of living matter disregards all known law of non-living matter, how can it, beyond the microscope limit, be divided into smaller particles that obey that law? Then why this plea from the known to the unknown? How much better is this, from the scientifically-inspired Tyndall, than the story of Genesis: "In the region beyond the microscope limit," he says, "the poles of the atoms are arranged, that tendency is given to their powers, so that when the poles and powers have free action and proper stimulus, in a suitable environment, they determine the first germ, and afterward the complete organism." In all candor and seriousness, is this all that can be substituted, as the basis of human belief concerning the awful problem of life and its results, for that science-rejected story: "And the Lord God formed man of the dust of the ground, and breathed into his nostrils the breath of life, and he became a living soul." For the purpose of this argument I am neither affirming nor denying—only contrasting. Each must stand as the plain written record, upon which the acceptors of each must interpret for themselves. I am only quoting for the mind that has presumably formed no opinion.

Let us not refuse to look at truth—or facts, which are the ultimates of truth—but let us beware how we follow imaginings from facts. As an eminent writer on science has tersely and but too truly said: "For many years past the advocates of various physical doctrines of life have been encouraged in every possible way. A large section of the public, it appears, has desired to be taught such views. The statements have been heartily welcomed by the most advanced writers in the periodical literature of our time, who have hailed vague assertions as brilliant discoveries. The merest shadow which appeared to tell in favor of a material hypothesis has been repeated, embellished and forced into notoriety, while researches, in the course of which facts have been discovered favorable to other hypotheses, have been rejected with contempt or ignored."

While this may be taken as strong coloring, but none too much so for one class of people, it has its counterpart in the other extreme, that the advocates of a special creation have too often seized upon a fact that mitigated against the material side and forced it to do duty for every crude dogma which a non-scientific theology assumes to fulminate as an oracle of the unknown. Much of the so-called skepticism of the time is rather a protest against ecclesiasticism in all the affairs of life, not only as to things of faith, but even to the functions of intellectual induction and growth. The intelligent observer of to-day admits that there is less real skepticism among intelligent minds than at any modern period; but, as related to the dogmas of medieval and pre-modern theology, skepticism is almost universal. The deeper men drink at the fountain of knowledge, the more reverential they become, and the higher they exalt the Supreme power in the universe; but they reject that which thunders authority without the lightnings of knowledge, which alone proclaim its authentic mission. If both sides will allow the

growth of knowledge to see God in its own light, and interpret His laws from its own comprehension, without, on one hand, consigning them to the penalties of perdition, or, on the other, banishing them to the outer darkness of scientific ignorance, the churches would be better filled with the people of science and the halls of science more crowded with the disciples of theology than now, and both be benefitted by the thorough cultivation of all sides of humanity and by the sustenance which the hunger of knowledge and faith both would receive.

But, to return. If the advocates of the physical theory of life are to be taken at their word, they must be in possession of facts to justify them in holding it as a belief that the existing phenomena of life are only the result or the consequences of change, that these changes are the result of others, back, link by link, until a time existed when matter was in such fortuitous conditions as, "with suitable environment, to determine the first germ," and from that time to this, through illimitable ages, no such fortuitous conditions have recurred. Not only must they have facts upon which to base such conviction, but they must have what no fact has yet been found to sustain– that these first germs, or this first germ, was itself endowed with the power and functions of illimitable perpetuation and change. As a germ it must have been both infinite in power and immortal in perpetuity; for all science is agreed, all investigation concurs and all experiment consents that there is no form of life known, or possible to be known, that has not obtained its life from a pre-existing and kindred form of life. Here we again return to the starting-point, having traveled to it by the same negative process as before. And what more profoundly supernatural dogma was ever propounded to the human intellect for belief? It is infinitely more shadowy and difficult to grasp than the crudest of the assertions of special creation.

But what is the fact? In all that has been proven, in all that has been seen, there is not a particle of evidence as to the changes which immediately precede the production of anything that is living. That is a mystery beyond all efforts, so far, to tear it from its secret.

We are told that all things are ordered, controlled and upheld by law, but it is a law of which we do not know, while all analogy teaches us that law is from consciousness, intelligence, will and power. If the law is beyond the reading of our methods, the source of the law cannot be explored and its functions made a thing of finite solution. Even admitting that all that is claimed is true, that mere matter was the cause and origin of all life, still the question is unanswered. By what, by whom, from whence, was matter thus endowed with this tremendous power and this creative energy? Creation it is, be it that it was spoken into existence in a moment, or that it wove its myriad mazes of life through illimitable and inconceivable ages. Either way, it is the same mystery; and while the conception of creation amazes us with its transcendent exercise of infinite power, evolution bewilders us by the eternal persistence and the immeasurable profoundness of the divine energy.

But let us go back again to what our eyes see, to what our sense can observe,

in the working of this inscrutable agent that builds up all living organisms, for to our apprehension it is the most wonderful thing in the whole range of scientific observation and fact. The animal organism has been likened to a machine that is made, and runs as it is supplied with force or the fuel to run it. But a machine is made by a machinist, is operated by an attendant, is controlled by a force outside of it that compels it to the performance of its task. A watch has its power from the tension of its spring, and an engine from its fuel, but this power, unlike the watch, has no two ticks alike, nor is it like the engine, for when its fires are out they can never be re-lighted. Nor is this agent of rare appearance, but abundant in every thing that lives, and can be seen and examined by any one who has even an object glass of seven hundred diameters magnifying power. As we are told by an eminent authority, "There is not at any period of life, in health or in disease, a portion of any tissue of a man' body the size of a pin's head, with perhaps the single exception of the teeth of the adult in old age, that does not contain some of this living matter in which purely vital phenomena take place. Nor is there an action characteristic of living beings, at any period of their existence, in which this living matter does not play an all-important part." So we learn that this wonderful agent, by which and from which all life is possible, and through and by which all growth is derived, is not something that is rarely seen or at all mysterious as to existence, but that it is all-pervading and infinite in abundance.

It is not proposed to give a treatise on the manner in which living organisms grow, but it is necessary to describe it as comprehensively as may be done briefly, that the process or phenomena may be understood as bearing on the problem—for we must accept its operations as from law, and in the argument this law must prevail over hypothesis. If theories are not in harmony with it, then they must fail. And law, unvarying, unchangeable, inflexible, is the essence of the doctrines upon which the theory of evolution is based.

These little life-agents we must accept as existing, for research has found them, studied them and demonstrated their work. These little agents or workers were first seemingly one mass. As they multiply in the earlier life they are close to one another. To form organism, they must not only multiply, but separate, and we find they do both. At this early stage it is impossible to tell the functions of any of them, as to which shall spin a nerve, which form a pigment, which construct a vein or artery, or become a blood corpuscle, or what ones shall ultimately build that wonderfully complex machinery of the brain, or descend to the foundation masonry of bone, or the superincumbent structure of muscle and tissue. But they find each its allotted work and do all these things. And when you take the one that forms the gray matter of the brain, and the one that deposits the nails at the ends of the fingers, you cannot detect any difference between them. That there is a difference, their work shows, but it is a difference beyond any terms of science to express. You may say it is molecular change, but, then, what induces the change? If it works by law, what is the law? The

man of faith may guess at it, but surely not the man of science, nor, above all, the advocates of the material theory of life. With these, hypothesis is heresy.

The most remarkable work of these little agents is the nerves, nerve centers and cells. It was at one time thought that these cells were the ultimate forms of life, but it is now known that they are only the reservoirs of nerve force—the cups of the human battery—so to speak, from and to which run the nerve wires of the telegraphic system. The nerves are not in them, but around them. The currents starting from a cell are conducted along many fine fibers, which, by subdivision or branching of the original one, return, as we must conclude, to the place of starting. The assumption that the nerve fiber itself possesses peculiar properties from the material of which it is composed, to account for its action, has no support from observation. So far as we know, a hair might afford an equally conducting medium. They are the cords which transmit the nerve force, and this is all we know. The ganglia, or nerve centers, are now found to be (to carry out the simile) simply relay batteries, by which a supply of force is drawn at distances from the source of impulse, by which the original force acts without diminution of power. Every artery is wound round with this wonderful nerve structure, and thus is the supply of blood, from contraction of the nerves or relaxation, regulated to admit of all emotions.

As we ascend into the brain we see no difference in the character of these little workers; they appear to be in every respect the same, but they increase in number beyond all calculation. In fact, the greater portion of the gray matter consists of these little agents, and the cells and the fibers that surround them in all directions and ramifying among them. Their very multitude is enough to tell us that here is located the supreme office and function of these living particles, and that all below is but the instrument with which it works. What these are we do not know, how they obtain their functions we cannot tell, but what they appear to be we can see. I will, in describing, use other words than my own, that there may be no mistake. "Near the surface of the gray matter of the brain, in the extensive layer above the planes in which the caudate nerve cells are situated, are multitudes of very small bioplasts lying among the finest branches of the nerve fibers. In some places there are aggregations or collections of these bodies. They are nearly spherical, are extremely delicate, and become disintegrated very soon after death. Some sections of the gray matter appear to consist entirely of these bodies, so great is their numbers. Some seem to be connected by very delicate processes of the same transparent material." These masses are situated so as to be capable of influencing and intended to influence the fine nerve fibers that ramify among them, as the slightest change in form or position could not fail to affect the currents traversing these fibers. And we are led with irresistible logic to the conclusion that "these vital movements or vibrations occurring in matter of excessive tenuity constitute, or are the immediate consequences of, mental vital action. The directions in which the living matter is made to move by the conscious life power which directs it will determine the particular cords of the nerve mechanism to be struck. The special movements may be the expression of the

inward ideas. If this be so, mind is the vital power which is associated with this most exalted form of living matter."

Now, this is all we know, and, so far as the power of instruments has been able to aid us, it is the limit of the knowable. And can any one say that the problem is solved? The same question again presents itself: Whence the power which sets in motion to conscious results this wonderful machinery? It has been said that with higher powers this question may be answered. But this is not an answer. Still, there is a partial answer to this, for since this paper was begun an instrument of immensely increased power has been perfected, far in advance of all predecessors, and seemingly beyond what was deemed possible, yet it has no "may be" to give us. It returns the same answer to the questioner—these living particles are the same.

We may, then, stop here, so far as actual knowledge or facts are concerned, as beyond this everything is conjectural or hypothetical. Now, what do these facts teach us as to the cause or origin of life? Do they explain it? No. They only enlarge our perception of the methods by which the force we call life works, and add to our knowledge of phenomena. But it does teach us that, whatever may be the origin, all is under law, as unchangeable as it is wonderful, and as certain in results as it is mysterious in operation.

Now let us go back again to the point of difference between the advocates of special creation by supernatural power, on the one hand, and those of evolution, on the other, with this law in our mind, and its unvarying and universal mode of working. And here let it be said that no one holds in higher esteem and admiration those grand masters in science, nor is there any one whose gratitude goes out to them more abundantly for the illumination they have shed upon the paths of knowledge and in the minds of men. Their devotion, patience and painstaking research, and the wonderful results of their labors to the sum of knowledge, place them among the chief benefactors of mankind, and it would be the presumption of ignorance itself to treat lightly the conclusions to which any of the illustrious company may have felt themselves impelled. But the very freedom they have made possible to the thinker is best improved in weighing these conclusions, and even in dissent their work is more honored than in unthinking and servile acceptance and indiscriminate adulation. They have opened the book of nature to us, and we must read its facts in the same independent spirit that gave it authorship.

This doctrine of evolution, then, must be examined in the light of the facts we have been considering, and in harmony with this law that we know to be at the base of all living organism. We have seen what must be believed to accept the solution of the problem of life, as coming from spontaneous generation. We are equally at a loss as to the antecedent causes producing life from this beginning, as we are to the directing forces and primal inspiration of living phenomena as we see and know them. But we all agree that, whatever they may have been, they no longer exist, and that type and species are permanent, and, so far as our knowing reaches, have been from the happening that produced life itself. There is no change in the law. These living forms of matter have worked in the

same mysterious way ever since life was that they do now. Let us see how one can be and with it the other; or, rather, let us see how impossible it is that both should be.

Haeckel in his work on creation, gives great prominence to the development of the fœtus in various animals and man to show that there is a sameness that he claims as declaring a common origin, or a common descent from the same primordial germ. If we reasoned by the eye alone, his proof would be good. But we know that all germs are formless, and it is the essence of the inquiry how this same appearing and utterly structureless matter comes to grow into so many differing organisms, from the simplest plant structure to the culmination of all forms in man. And it must be said that the hypothesis is all assumed for we have failed to find a single fact to sustain the conclusion; but, for the sake of argument, let us assume that it is so. Is it not as great a miracle that all this diversity should flow from one germ as that there should be a germ for each? And is it not equally as necessary to have a controlling power for the one as the other?

It seems in the one case possible and reasonable, while in the other it demands a molding agency far more miraculous, and a higher degree of persistent supervision or providence, to have presided over the processes they call differentiation and the adjuncts of environment. Mr. Darwin alone, of the many eminent men who have thought and taught on this subject, has assumed to give us the method or the law, and certainly none has a higher claim, for among the illustrious few no one approaches him in the wide field of research, the patient and minute investigation, and the wonderful accumulation of facts that he has gathered to enrich the intellectual treasures of the world. He has been a loving and a diligent student of nature, and it is not a thing of surprise that, finding so much in her store-house that suggests self-conscious working and a purpose in even her most elementary forms, he should have esteemed her as the origin and sum of her own divinity.

This law of Mr. Darwin, which has been accepted by all his contemporaries who hold to the idea of spontaneous generation, he calls that of natural selection and the survival of the fittest—strongest. The logic of the working of this law is that each new form of life possesses something superior to that which preceded it, and, thus, rising through unknowable cycles, it ultimated in man. It is a beautiful theory, and addresses itself with great and captivating power to the imaginative intellect, and is itself a miracle of ages, in contrast to the other hypothesis, which is a miracle of a given time. The one is a miracle of spoken power; the other of power in persistence.

But, then, it has its unanswered problems. Is this power of persistent and upward change still a property of matter, and are men to become immortal by evolution into angels? If not, what has rendered impossible in the future what has been the law of the past? And if such is the law, how has one type progressed while others stood still? For we do know from the witnesses in the oldest rocks that the same forms of life existed before they were formed that exist on the earth to-day. But it is not the purpose to travel over this much-beaten track.

of controversy and argument farther than to say that we have never yet seen these satisfactorily answered. The reply "that it may be discovered" will not do for exact science. We are familiar with supposition and assertion from the other side, because that is the original basis with them. We have to excuse it in theology, for it is its foundation, but we cannot admit the overthrow of one assumption by another. It reminds us, if our theological friends will pardon the digression, of their position toward a troublesome intruder in their own domain. After basing their whole system of faith upon supernatural origin and authority alone, and demonstrating their every proposition and article of creed upon the intercourse between man and the supernatural, they deny that it is any longer possible in this world, and say that there is more knowledge attainable in that way. The two thus arrive at the same point again by diverse paths, and complete the circle from opposite directions. Evolution is the method, but it is no longer operative. Divine interposition and supernatural authority is the warrant of faith, but men can no longer receive light through channels open for thousands of years; neither can object if each is questioned as to its authority for thus delivering the oracles.

But let us come back to the question, and I will evoke only one more illustration as to the impossibilty of accepting this law of natural selection and the survival of the fittest as solving the difficulties that have heretofore attended the theory of spontaneous generation. And, again, I must apologize for the manner in which this illustration is stated, and reaffirm my perfect respect and admiration for the eminent authority it assumes to criticise.

Sometimes the point of an argument or the force of a proposition is made clearer by contrast, and if the manner is colored by levity it often serves emphasis better than grave and dignified postulate. If in what follows there is an apparent violation of correct taste, it will be from the unfortunate method in which the contrast is conveyed, not in the intention which prompts its employment or from want of respect due to eminence in any department of knowledge.

Let us follow the working of the law in the one single instance in which man steps from a lower form of life in obedience to it and appears as we find him. We have seen how these little life-agents work in building up living organisms, and that they follow a law as unvarying as that which controls the stars in their courses. Now, we are told that the two types that come nearest each other are man and the Simian family, or that, if man is the result of evolution, the apes are the nearest of kin—that they are our ancestors. This is one of the strong points of evolution, and without it man cannot be accounted for.

We will take one controlling fact, of undisputed existence by investigation on all sides, and see if we can make it consistent with the theory which Mr. Huxley tells us has finally been demonstrated. It is not that because an Eocene horse had five toes, that therefore man once had a tail, which is the logic of the three American lectures, but we ask that the query presented be demonstrated before we accept the question as closed from the case of the horse.

These little agents build, then, after an unchanging plan, and how do they make an ape or a monkey, and how a man? And, to make it brief, only one part of

their work will be noted, and that upon the portion of the organism in which the radical difference exists between man and all other living things, the place where his patent of nobility is stamped, and where he bears the seal of his power to hold dominion over nature and all other forms of life—the brain. It is a law of development that every type of life grows exactly in the same way, beginning in the same way, growing alike, now this part developed, now this function apparent, and the last, so to speak, finishing touch given at the same points with the exactness of unchanging law.

Now, take the brain of the monkey or ape, and we find that it is the temporal lobe of the brain that is first formed and developed, and the anterior lobe afterward. In man the very reverse of this is the fact. In him it is the frontal lobe that is first built up and most quickly and promptly formed, the lateral or temporal lobe coming last. So we find that in the formative process of the brain of these two families there is a direct opposition, a complete reversal of plan.

Surely this fact requires something more by way of explanation than the mere assertion that, by a "proper stimulus in a suitable environment," this law of growth was set aside, reversed, and a new being the result. But what, according to this theory of natural selection and the survival of the fittest, are we called upon to believe? Only this, that at some inconceivably remote time some powerful anthropoid ape, having selected the most perfect and beautiful of his race for a wife, one fit to wed with princes, and by holding his prize, by virtue of his prowess, against all rivals, became by great pre-eminence the first of his race, thus fulfilling the law. And, now in compliment to this supreme demonstration of physical powers, these little life agents, deeming the last form of ape evolution complete, which had from the first been laying the foundations of the brain in the temporal lobe, suddenly reversed the order, and proceeded to build up at once the frontal lobe of the first-born of this royal pair. Or, they changed a law of life and development that enabled the son and heir to supplant forever the authors of his being—a proof for the eternity of the future of the divinity of this law of the strongest. And who now dare say that, in morals, might does not make right? If we accept the one as the law of life, we must accept the other as the law of morals. The one is only the correlative of the other.

You will see that no favoring condition has been kept back, but we have made the premise as broad as the imagination will warrant. It is in no spirit of levity that the parallel is thus drawn, but because the logic of the theory, as laid down by the Moses of evolution, paints the picture. Taking facts as they exist, and the hypothesis as stated by its author, the result could have come in no other way. Can we, knowing the wonderful and seemingly self-conscious action of these particles of living matter, believe that they must at one time have reversed the law of their work, in deference to any influence arising out of the conditions or environments of any form of life? If we do, then the gods and demi-gods of mythology were as told of them, and fauns and satyrs, Pan and Centaur, but the children of natural selection. The statement of the theory as to what must have been its practical workings, answers it. It is only hypothesis.

And here, perhaps, this paper should close, with the conclusion that there is no physical basis upon which a knowledge of how life came can rest. So far as those who assume to answer for science, there has been no answer. But have research and discovery afforded no clue to a better or more satisfactory understanding of the problem, and are we as far as before from a knowledge of it? I do not think so. But there is this I do believe: as long as we follow the ideal upon which both theology and science have sought an answer—a power working by comprehensive, human methods—the pursuit will be barren of result. There are some things that we do know. We know that life, as we see it, is from a germ, and that the phenomena of life, that we call growth, are from a multiplication of that germ, and that they are susceptible of observation by the senses and may be studied. The vitalizing principle of the germ is what we do not know, and what no science that has been possible, or that we can conceive of, can open to us.

What suggests itself in this direction is stated with the greatest diffidence and with no pride of opinion, but with every apology which should precede mere speculative intrusion. The inverse method is best to arrive at an intelligible idea of the fact of life and its phenomena. Instead of placing ourselves at the imaginary stand-point of the Infinite Power, and then constructing the universe and ourselves for Him, why not reach out from our position and endeavor to grasp that which preceded us?

The religious in us is a fact, and why not reason from this as well as from any fact in physics? It is a fact, the ultimate of a cause. What is the cause? A pre-existent or a superior power of like quality. It finds expression through phenomena resulting from life. It must come from the functions of that form of life which we are. Then there must be a medium for its expression. We can see all the working of this medium, and only fail to see the impulse. We can only comprehend what is not us by what is us. There is a power, a wisdom, a function, a will, greater than we, because the all in us only results in that conception. And we must furnish the explanation. There can be no other method. We cannot obtain knowledge from without as to anything—all knowledge is but our own perception of what is objective. The fact, then, that science is formulated and taught to all minds alike is proof that all mind is from one source, and that source must be the unit of all intelligence. Thus scientific method itself teaches the oneness of all mind and its origin from a common source. Matter, then, being the one universal medium of all phenomena, we must find the "beginning" in the ultimate of matter. And what does this fact of reason lead us to in this direction? That all our sensations come from forms of matter within ourselves, corresponding to the sensation. For example, the eye receives light and expresses it to the mind from the fact that it receives the light upon its peculiar structure, and this structure is but light itself built into this form by those mysterious forms of living matter we have been considering. This illustration will explain the hypothesis advanced. And so of all organism. How can it be otherwise? We can comprehend this, but we cannot conceive it in any other way. And what other process are we capable of outside ourselves?

Have, then, our physical methods been in the right direction? Analogy is the best guide in the interpretation of nature and her laws. Instead of taking matter as dead and subjecting it to blows to separate it — for chemistry, after all, is but force applied to break it into atoms — let us allow it life. There is nothing in the universe that is dead. Matter endowed with life at once becomes the expression of the will that gives it form. It thus becomes instinct with faculty, and must itself possess property function. This presents it to us in a twofold aspect. And can you conceive of anything in nature that has not duality? Why not, then, matter have this principle? If everything in nature formed of matter has it, must not the forming material have it also? To deny it is only to use words. To affirm it is to be supported by everything that we know. This duality may be called body and soul. The body we can know, the soul we must recognize through the only mode of perception given us—reason. The unknown can only be conceived of through the known.

This analogy we find all through nature, and is best illustrated by our conception of the imponderable forces, as electricity, magnetism, etc., when we call it positive and negative. Now, all that is needed is to concede the universe as consisting of matter — not the suns and worlds only, but space as well—and the difficulties rapidly disappear. And why not? We talk of heat and light, and other intangible things, as force. We know they have motion, and is not motion, momentum, impossible without weight? If they have this motion, they have weight; and if they have weight, they are matter. And as they move through or in space, traverse it, space is occupied by or is itself but a form of matter.

The facts of discovery in science all tend in this one direction—the unity of matter. There is no single instance of a real advance in the knowledge of facts that does not support this hypothesis, and in the most recent discoveries demonstration has almost been reached. As at one time the telescope became but the demonstrator of Kepler's theories, so now the spectroscope and the laboratory are fulfilling the predictions for reaching minds, or, as they are too sneeringly called, theories of "scientific imagination." The mind is, after all, being proved to be superior to methods or instruments. And as we have so many proofs by practical investigation of the correctness of hypothesis in this direction, why should we reject the unproved, while the proved are all logically in harmony? We forget they, too, were once rejected.

Take the most recent discoveries as to the sun — all are in harmony. The telescope only told us of magnitude and appearances, but the spectroscope has shown us that this incandescent sphere presents differing conditions as induced by differing states of its matter. We find the mass itself conveying the fact that its matter is akin to that of our own world. Above this that same matter, in a more fluidic state, is the source of that light which it pours unceasingly upon its system of worlds and out into space beyond. And above this, in a still more attenuated form, it bursts into an immeasurable glory of colors. How long since color has taken its place as a potential agent in the universe of life? It is hardly yet admitted to the charmed circle of science. And beyond this, in still more refined

conditions, the unity of all matter is said to have been found. And, lastly, the magnificently suggestive discovery of Crookes of the fourth state of matter, which demonstrates by physical methods the materiality of light. But I must stop somewhere, or this fascinating field will widen beyond all limits of the occasion.

Here, then, is experimental science on the very borderland of the infinite, and the imagination almost reels with expectation as the next step is contemplated—the ultimate analysis of matter. Bearing in mind this dual principle, what must it be? Is it not what we call spirit? And why not? From the lowest forms we can trace this principle up and up, to worlds, to suns, to space, even to the very threshold from whence matter assumes the functions of the living—to where the meeting with its vitalizing principle lies only behind the veil. If we cannot pass into the Holy of Holies, we can bow before the presence of the unknown as it passes to our view, and know that there is no beyond. Here all hypotheses can meet, and there need be no dissension as to the source of all life and all that flows from life. Here matter becomes immortal by association with the principle of immortality, here miracle ceases, and all the required conditions are fulfilled. Here the man of faith, illumined by the light of the ultimate, can worship a God that satisfies the loftiest reach of the most exalted intelligence instructed by the profoundest knowledge, while the man of science can gratify his most exacting demands for a first cause, working only by everlasting and inflexible law. And there is nothing there to disturb the simplest faith of the darkest intelligence. Surely we need not fear to bridge this boundary between the known and the unknown by a scientific faith which so fully satisfies all aspirations and gives to the soul, after its struggle toward the beginning, the solace of requital and repose.

THE RELATION OF SUPERSTITION, OF SKEPTICISM AND OF FAITH TO THE PROGRESS OF SCIENCE.*

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As the topic is broad and the time short, I proceed, without introduction to the definition of terms. By superstition I mean belief without evidence, and even contrary to evidence; by skepticism, the withholding of belief upon good evidence; and by faith, I mean belief on sufficient evidence. Superstition is over-belief, skepticism is under-belief, and faith is reasonable belief.

All these tendencies of the human mind have in turn, exerted a controlling influence upon the development of science, to advance or to retard it, to build it up or to tear it down. Nor are they things of the dead past. They exist and are operative, to-day, as in times gone by.

I. There is scarcely a branch of science which is unaffected by superstition, and surely not the medical science. It has been and still is the bane of medicine.

* Read at the Commencement Exercises of the Kansas City College of Physicians and Surgeons, March 4, 1879.

Go to any drug store and how large a space is given to nostrums, whose virtues are more wonderful than any tincture of ancient fable. Without any great stretch of the imagination you might easily fancy yourself in the laboratory of some weird Alchemist, who had discovered the elixir of life, which was to make old folks young; crooked ones straight, and ugly ones beautiful. The eagerness with which these things are bought by the people is the measure of their superstition, and also the measure of the difficulty with which true science has to contend.

Superstition has always been the irreconcileable enemy of all scientific progress. It has placed itself in direct opposition to every movement which was fitted to check or to bring to an end its own dark reign. It begets a state of mind, which is the most antagonistic to scientific investigation. To pursue science successfully, the mind must be free from all trammels, which would in any way restrain the activity of its powers. Superstition, by the awe and dread which it produces, broods like a nightmare over the mind. How could the Hindoo astronomer investigate eclipses with any kind of success, while the awful dread hung about his soul, that some giant dragon was about to gorge the sun, and to hurl the universe into hopeless ruin? How could the Christian astronomer investigate the properties and laws of comets, with the fear of a general conflagration haunting his mind? What encouragement to endeavors of any kind could there be, so long as men fully believed that their lives and destiny depended on being born under this or that constellation? The belief that every mountain den was peopled with all conceivable goblins and malicious gnomes, who would throw their dreadful spells upon every intruder into their domain, most effectually checked geographical pursuits. Investigators did not penetrate unknown seas, lest they should meet the terrible ghost-ships, huge kraken and the like. The warping and deadening influence of superstition invaded every department of life, and all professions. Incorruptible judges were overborne in their decisions by the belief in witches and sorcerers, and leagues with the devil. They would listen to testimony, telling of old women riding on broomsticks through the air or transforming themselves into wolves and devouring all the flocks of the neighborhood, with the utmost credulity. Upon such evidence they would condemn men and women to the flames, with far less compunction than the modern judge condemns the murderer, upon the clearest evidence of his guilt, to the gallows.

The truth or falsity of the evidence never seems to have entered their minds. All they considered was the amount of evidence. If this was abundant, its truthfulness was never questioned. Chilperic, one of the Kings of the Franks, was assassinated. His heir was only two years old. A brother of the murdered king did not hesitate to cast a doubt upon the legitimacy of the infant Clotair. But the mother, Fredegonda, repaired her somewhat questionable reputation and secured the throne to her son, by appearing at the altar with three bishops and three hundred noblemen, who all swore with her as to the legitimacy of the little prince, and no further doubts were ventured on the delicate subject. The superstitions connected with law and evidence would fill many quartos.

There have been periods when the names physician and magician were used

synonymously. Doctors were looked upon as dealers in the dark art, which was to a very great extent true. Superstition settled down like an incubus upon the minds of men. How could the medical profession go into an investigation of the laws of the human constitution so long as the belief held sway over their minds that some magical hocus-pocus would be more availing than all science?

It is wonderful how the greatest minds, which have done the most to emancipate science, should still remain under the power of some prevailing superstition. The great Kepler, who gave astronomy such a start forward, could never free himself from the shackles of astrology. The clear vision of Francis Bacon was often dammed and perverted by gross superstitions.

After the restoration of Charles II, a superstitious reverence for the divine right of kings prevailed among certain classes in England. The King sent to the Royal Society, which was composed of the leading scientific men of the realm, for them to explain how it is, that when a *live* fish is thrown into a basin of water, the basin, water and fish do not weigh more than the basin and water before the fish was thrown in; whereas, when a dead fish is employed, the weight of the whole is exactly equal to the added weights of the basin, water and fish. Much learned discussion followed, several elaborate papers were read, and many theories were propounded. At last some one suggested that the experiment be made. This brought down a storm of abuse upon his head. To doubt was considered an insult to his majesty and tantamount to an act of constructive treason. The experiment, however, was made, and to the confusion of the wise men of Gotham, it was found that the weight was exactly the same, whether a dead or a live fish were used. The superstitious reverence for royalty overbore their common sense.

Again superstition, by the introduction of the supernatural into all the phenomena of nature and life, took away the motive to scientific investigation and research. If everything be done immediately by the finger of God, there is no room for reason, nor for research into the causes of things, which is the true work of science. God does it and that is all that can be said. Whenever such a belief prevails, the efforts of men will be to find some means of influencing Deity, rather than searching into the causes of things. Superstition will soon invent ways and means. Talismanic words will be more effective than the profoundest knowledge of things. Where now would be the motive to the study of medicine, if all men believed that the mutterings of some old witch over a kettle of boiling herbs would communicate to them greater healing power than the best compounds which science and skill can produce? Suppose the belief was universa that the elixir of some quack had greater virtue than man was to find in the prescriptions of the whole medical profession. Who would study medicine? Against this form of superstition physicians have had to contend in all the past, and to-day it is one of the greatest hindrances in the way of success. It is astonishing how few people follow the advice of their doctor implicitly. The most mingle some superstitious notions with his directions. On this account very often, the greatest ignorance will be preferred to the greatest skill, simply because

ignorance will cater to superstition and science will not. If some trifling thing is to supersede intelligence, knowledge and skill, it is only the few that love science for its own sake will ever pursue it. Superstition, by taking away the motive to endeavor, produces a complete stagnation in every department of life. Italicus, a Christian horse-racer was beaten repeatedly on the course, by the pagan Duamvir of Gaza. Instead of trying to improve his stock by breeding and training, Italicus made application to St. Hilarion for help. He told the Saint that it never would do to let the heathen beat the Christian at the horse race—it would certainly bring disgrace upon Christianity. At his earnest solicitation Hilarion furnished him with some holy water with which he sprinkled his horses just before starting in the race; and now they shot like arrows by all competitors, leaving them far behind. Against such jockeying there was no redress.

It is not only in this indirect way that superstition has hindered the progress of science, but it has offered positive resistance. It has resorted to all possible means to check and bring to an end scientific investigation. When the philosophers undertook to prove the existence of the antipodes, Cosmas entered the strife, and tried to show from Scripture that they were an impossibility. He tried to stab a scientific principle with a text. He said St. Paul taught that all men were made to live on the *face* of the earth, therefore it followed, that they could not live on the *back* of the earth. This seems to me to be the most contemptible and impious use to which science can be put. Cosmas then tells us what he considers to be the orthodox form of the earth. "It is a flat parallelogram with high mountains on all sides to which the sky is glued." What a glue that must have been! He was only the first of a long line of ecclesiastics who ignorantly tried to crush the first risings of science with a load of scriptural texts.

Superstition was not contented with seeking to argue down and to frown down science, but its great effort has been to force it down. It has instituted laws against it; it has kindled the fires of persecution and resorted to every unfair means to banish it from the earth. This is the relation of superstition to science.

II. What is the relation of Skepticism to science? It has done a good work in the suppression of superstition, and in clearing away its practically evil consequences; but in combatting superstition it has gone to the opposite extreme of denial and negation, which is well nigh as fatal to scientific progress as the evil which it swept away, for if superstition believes too much, skepticism believes too little. It has gendered a narrow-minded dogmatism, which refuses to accept anything that cannot be submitted to sensuous tests and experiments, and in this way virtually plays into the hands of superstition; for science becomes a poor shrunken thing when you take from it all that cannot be demonstrated and submitted to the senses. We talk, indeed, of gravitation, caloric, electricity and magnetism as if we knew what they are; yet these are but expressions of our ignorance, fence-words, which show that we have reached the outermost limits of our knowledge. We observe certain phenomena and we refer them to a supposed cause which we name the force of gravity. This causal power has never

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been observed, but only thought. We know there is something, but what it is we do not know. Another class of phenomena passes before us; we bind them up into a sheaf and label them electricity. Why this new name? Have we found a new power? Have we gone behind phenomena and discovered a new cause? Not at all. We have observed two distinct classes of effects, and we refer them to two supposed causes; these causes are believed — not seen nor known. The same is true in regard to all the forces of nature. Science, without forces, would be nothing more than a barren collection of facts. Skepticism, to be consistent, should deny the existence of forces, for they cannot be seen nor demonstrated. What they are we know not. If you can show me force, I can show you God. Skepticism has developed a system of doubt, which denies everything which lies without the narrow circle of its experience. In this respect it has proved itself to be one of the great hindrances to scientific progress. It has begotten a race of doubters whose only achievement has been negation. A few illustrations from the history of science will show the truth of this assertion.

The Phœnician sailors in the service of Pharaoh Necho, King of Egypt, reported that they had circumnavigated Africa. The skeptics of that day ridiculed them for the very statement which to us is the greatest confirmation that they made the journey, namely, that mariners declared that during part of the time the sun rose and set upon their right—that is, in the northern half of the heavens, as with us in this latitude his course is through the southern half of the heavens. The Venetian doubters nick-named their famous traveler, Marco Polo, Mr. Million, because he reported cities in China with several million inhabitants. Late researches in China and her coasts have shown the truthfulness and exactness of this traveler's reports. Our own day has witnessed the same narrow skepticism. The discoveries of Livingston, of Krapf and of Speke were all disputed and pronounced impossible by learned geographers. When these discoverers announced the vast lake Victoria Nianza, in equatorial Africa, the idea was ridiculed until it was confirmed by later travelers. When the German missionaries made known to the learned world a mountain in Central Africa covered with perpetual snow, they were laughed at. It was said that no such mountain could exist in that region. The skeptics claimed that the missionaries mistook dazzling quartz or chalk for snow. But later discoverers have ascended the mountain and found snow enough. Copernicus, the father of the present system of astronomy, experienced far more opposition from the skeptics of his day than from the church. His great work on the heliocentric theory was dedicated to the Pope; and Cardinal Schomberg was his special patron. The Newtonian system of gravitation was opposed by the great philosophers of the last part of the seventeenth century and the beginning of the eighteenth. It had to fight its way against persistent skepticism. That it was possible for stones to fall from the sky was looked at skeptically by the wise academy of Paris. To them, showers of stones were as absurd as showers of frogs.

Nor has the medical profession been free from this narrow-minded skepticism. Those great men who have made epochs in the science have had to con-

tend against great and prolonged skeptical opposition. Harvey spent eight years in research and investigation before he made known his views in regard to the circulation of the blood. He repeated and verified his experiments over and over again. He published his thoughts on this great subject in a modest tract; the language and style were simple, perspicuous and conclusive, but it was received with jeers and ridicule on all sides. He was called a crack-brained fool. For some time he did not make a single convert, and the little practice that he had dwindled to almost nothing. He seemed to be without a friend. Skepticism and superstition joined hands in their *generous* work of destruction. He was denounced as seeking to subvert the authority of the Scripture, and to undermine the foundations of modesty and religion.

The difficulties which Jenner had to meet in making known one of the most beneficent discoveries ever known to science were even greater than those of Harvey. He heard one of the Glostershire milk-maids say: "I cannot take the small-pox, for I have had the cow-pox." This riveted his attention and he set about making experiments. When he mentioned to his friends his views of the prophylactic virtues of the cow pox, they laughed at him and threatened to expel him from their society if he harassed them any longer with his absurdities. He went to London and was so fortunate as to be under the celebrated John Hunter. He communicated his views to that great anatomist whose charge to him was: "Don't think, but try; be patient, be accurate." He returned home and continued his investigations. After twenty years he published them to the world. He gave twenty three cases of successful vaccination of individuals, to whom it was impossible to communicate small-pox by contagion or inoculation. This all went for nothing. The discovery was at first received with indifference and afterward with positive hostility. He went up to London to exhibit to the profession the process and successful results. He found all ears closed against his demonstrations. After waiting in the city for nearly three months, not a single physician could be induced to make a trial of his discovery. He was caricatured for his "attempt to bestialize the species by introducing into their systems the matter from a diseased cow." Here again superstition joined with skepticism. Vaccination was denounced from the pulpit. It was declared "that vaccinated children become ox-faced; that abscesses broke out to indicate the sprouting horns; that the countenance was gradually transformed into the visage of a cow, and the voice into bellowings of bulls," and yet the great Cuvier says of Jenner's discovery: "If vaccine were the only discovery of the epoch, it would serve to render it forever illustrious."

This register of willful skepticism might be extended indefinitely—a register that nearly corresponds with every valuable discovery in science, which has almost universally been disparaged by an obstinate skepticism. The stand-point of scientific skepticism is illustrated by that of the African prince, who threw a European into prison as an impostor because he told that in his country water became hard, like a stone, and that men and wagons traveled upon it as upon a highway. The negro had never seen water in any other than a fluid condition.

This was an unvarying fact withithin the limited circle of his experience, and yet he had generalized it into a universal law of nature. With the same narrowness, skepticism generalizes its one-sided empiricism into a universal law.

From all this we learn that skepticism is but the opposite side of superstition; that both have their origin in a narrow dogmatism which will tolerate nothing beyond its limited circle, and thus both become the antagonists to scientific progress.

III. What is the relation of Faith to the progress of science? I have defined faith as belief on sufficient evidence. The scientist observes certain phenomena of weight; upon experiment he finds that they are always the same under like circumstances. He necessarily refers them to some cause; that cause cannot be observed or known. Faith apprehends it and calls it gravity, and reason formulates its action into the law of gravitation. The sciences of astronomy and mechanics are proofs that this faith is well grounded.

Again, certain other uniform phenomena pass before the man of science; experiment reveals that their uniformity is not casual, but a law. By the necessities of his own mind he is compelled to refer them to some cause. No observation, no experiment, can reveal the cause. But Faith seizes it and he calls it electricity. The telegraph, the telephone and the electric light are the evidence that his faith is well founded. Other phenomena are referred to magnetism as their cause; others, to vital force; others, to nerve force. But none of these forces are objects of knowledge; they are believed. Without faith it is as impossible to be a scientific man as to be a religious man. Had Sir Isaac Newton doubted, as John Stuart Mill did, whether or no two and two might not equal five upon some far-off star, he never could have made the greatest scientific discovery that ever was made. Newton believed that mathematics were the same on the sun, on Jupiter, Neptune and the farthest star as upon our earth. His calculations were based on this belief, and the results show that his faith was built on a sure foundation.

Not only is faith the starting-point of science, but it has been the great factor in every onward movement. Between the beginning and end of every undertaking is a vast gulf which reason cannot see across, but faith links both ends together. Between sowing and reaping there is always a wide chasm which only faith can bridge. By faith the farmer sows; by faith the man of science launches out upon the unknown sea in search of truth; he knows not what is before him, yet faith enables him to press forward, 'mid surf and foam, toward the desired haven.

Almost every advance in science begins with hypothesis. Men are unable to explain certain facts; they suppose an explanation—that is, form an hypothesis. The formation of every hypothesis is faith. The scientist believes that such a theory will interpret such and such facts, and in this belief goes to work to test the truth of his hypothesis. Copernicus believed that the facts of the solar system could better be explained upon the supposition that the sun was the center of the system, than upon the old Ptolemaic hypothesis that the earth was the center. In this faith he went to work and mathematically proved the truth of

his hypothesis. He first believed, and afterward knew. Had he not at first seized the truth by faith, he could not have elaborated it by reason. Newton first believed in the law of gravitation, and then, by long and toilsome years of thought and calculation, he established it upon the incontrovertible basis of fact and reason. His was not a blind faith; it was a faith on sufficient proof.

One of the sublimest examples of faith is Columbus. He believed in the new world long before his eyes rested upon it. His faith threw a bridge across the Atlantic and in spirit landed him on the golden shores of America. With heroic patience he went from sovereign to sovereign of Europe, entreating them to accept from him the new world. When at last he was started for his prize, what was it that sustained him amid the perils of an adventurous navigation; amid cries of a mutinous crew, in whose angry eyes he saw his own death written? It was faith. By faith he lives and asks only for three days, the last of which presents to him the sight of the long hoped for land. There was nothing blind in this faith. He had accepted the truth that the earth is a sphere, and was confident that if he sailed westward he must strike land somewhere. This was the buttress upon which his faith was built.

Faith has been the distinguishing feature of those great men in the past, who have created epochs in their respective sciences. The true pioneers and promoters of science and of all departments of knowledge have invariably been men of faith. Without faith Copernicus, Kepler and Newton would never have made their discoveries in the material heavens; nor Linnæus, Cuvier and Agassiz in zoology; nor Lavoisier, Liebig and Faraday in chemistry. Faith has been the guiding star of all those elevated characters and noble spirits who have led their race onward.

Faith is the twin-sister of reason. Faith is winged, and flies on before, seizes the truth and holds it, until reason, with slow and labored step, comes up and identifies and proves it. By their union both become vigorous and beautiful, and science, art, philosophy and religion all move forward. By their severance faith dwindles into sickly superstition and reason into a barren skepticism, and all departments of truth wither as if the sirocco's blast had passed over them.

PALEONTOLOGY.

THE DINOSAURS OF THE ROCKY MOUNTAINS.

PROF. A. LAKES. COLORADO SCHOOL OF MINES.

From time to time we hear of discoveries of remains of gigantic monsters in our mountains. Some of these have been rather tall stories, founded on a certain amount of fact with an uncertain amount of imagination. Having ourselves

discovered several of these monsters, and having been in their close society for some weeks at Yale, we would offer to your readers some account of what is known of these huge forefathers of the race according to Prof. Marsh and the best authorities.

Many thousands, perhaps millions, of years a ago a long, tropical arm of the sea extended from the Gulf of Mexico over our western plains and Rocky Mountains, before the Rockies had attained their present height.

There were islands in those seas covered with semi-tropical firs and small palmettos, willows and other trees, and these islands were marshy in places. Along these marshes walked some of the most gigantic forms the world has ever seen. Monarchs of sea and land, these were the Dinosaurs or truly terrible lizards, and their remains are traceable for many hundreds of miles in a narrow belt of rock along the base of the Rocky Mountains. These creatures, which in their anatomy are intermediate between running birds, like the ostrich, and reptiles, such as crocodiles, were, for the most part, of enormous size; some from seventy to eighty feet in length and of great bulk; others were no larger than a cat. These were, for the most part, herbivorous in their habits. The skin of these animals was sometimes naked, sometimes furnished with an outside skeleton of bony shields like alligators, which they more resembled than most living animals. Some of their vertebræ had a hollow cavity looking toward the tail; hence they are called opisthocœlons, or hollow behind. The trunk ribs of the upper portion of the body were double-headed. The teeth were confined to jaws and implanted in distinct sockets. There were two pairs of limbs armed with claws, and in some cases the fore limbs were small in proportion to the hind limbs. The astragalus bone of the feet much resembles that of a bird. The Dinosaurs belong to what is called the Mesozoic period, the great age of reptiles, and when the chalk of England was forming at the bottom of the sea and over many parts of the old and new world, reptiles of the most extraordinary as well as gigantic forms were inhabiting both sea and land. Such were the igaunodons, megalosaurus, cetrosaurus and others. The iguanodon was a huge reptile twenty-five to thirty feet long, so called because its crenated teeth resembled those of the little modern iguana. It was herbivorous, and that it stood high may be judged from a thigh-bone five feet long, with a circumference of twenty-two inches. From the small size of its fore limbs, and occurrence of the tracks of pairs of gigantic three-toed footsteps left upon the rocks, it is indicated that it sometimes walked on its hind limbs like birds.

A still greater monster called the Cetrosaurus, found in Europe, was from forty to fifty feet long. It stood ten feet in height, acccording to Prof. Philips and was unmatched in size and strength by inhabitants of sea and land. As to whether it lived in sea or on land is a little doubtful, owing to some of its bones being found in marine, others in estuary and others in river accumulations. The structure of its limbs for walking implies that it took a "constitutional" at any rate, when so disposed, on "terra firma." The projection of the head of the femur in the acetabulum claims a free step. The large claws also imply land habits. It

may, however, have been amphibious, and the vertical height of the upper portion of the tail implies this. So we have a marsh loving animal dwelling amongst ferus, Cycads and Conifers, full of insects and small mammals. From its teeth it appears to have been herbivorous like the iguana.

The Meglosarus is another oolitic reptile from twenty to thirty feet long with tibia and femur each three feet, giving a leg of six or seven feet in length. The position of the head of the femur, at right angles with the shaft and long bones containing medullary cavities, implies that its habits were also terrestrial and carnivorous, as shown by its trenchant teeth, which are conical, compressed and with serrated edges. The fore limbs are very much smaller than the hind limbs there is no exoskeleton or outside skeleton. To these worthies we might add the Compsognathus of Sohlenhofer, which is more like a bird than the other Dinosaurs.

In true Dinosaurs the neck was short, the femur longer than the tibia and very much like a bird. The head of Compsognathus was furnished with hooked jaws, supported on a long slender neck; the fore limbs short and out of proportion to the hind limbs, and also like a bird in structure. The same relationship is noted in the tarsus, or ankle joint of the foot, which was united to the tibia, whilst again, in other respects it was unlike birds. Huxley considers that some of these creatures hopped like birds, in an erect position, to which class of beings, especially, the Compsognathus with its long neck, slight head, hollow bones and small fore limbs gives an extraordinary resemblance.

We now come to the description of our own domestic monsters which inhabit the Rocky Mountains.

On the flanks of the mountains is a narrow belt of strata, traceable for hundreds of miles, and marked here and there by bones of these gigantic Dinosaurs. Its position is above the Trias and below the hard sandstones of the Dacotah, which, by the way, contain many leaves of an extraordinary character, being the first Dicotyledons that are known upon this planet. By Dr. Hayden this belt was supposed to be cretaceous in age, but the abundant vertebrate remains discovered by Capt. H. C. Beckwith and myself, Prof. Mudge, and also by Mr. Lucas, at Cañon City, and by Mr. Williston, of Prof. Marsh's party, in Wyoming, prove, according to Prof. Marsh, its Jurassic age, and in honor of one of the largest monsters characteristic of these beds, he has called them the Atlantosaurus beds. The strata is estuary, being deposits of shale and sandstone, and seems to correspond to the Wealden, of Europe. Besides the Dinosaurs, remarkable crocodiles, tortoises and fishes, a pterodactyl and a mammal were discovered. These differ somewhat from the true Dinosaurs. The Atlantosaurus immanis, of Morrison, was at least 80 feet in length, and others equalled it in bulk. But with these terrible great lizards, there were also some scarcely terrible little lizards—the Nanosaurs, no larger than a cat. These Dinosaurs resembled somewhat the crocodiles of the Mesozoic period. We may give some of their most striking characteristics. The fore limbs and hind limbs of the Atlantosaurs were nearly equal in size, so there is no particular reason for their aping the bird by walking on their hind feet, that we know of. The carpal and tarsal bones were distinct. The

feet were plantigrade, and had five toes. The precaudal vertebræ contain large cavities, as it were bored in them, supposed to assist in lightening the great weight of the vertebræ and, being filled with air, are called pneumatic cavities The neural arches are united to the centre by suture. The sacral vertebræ, a number of vertebræ generally united to form a strong attachment for the tail, consist of not more than four in number, each having its transverse process.

There was a relative of his, called Diplodocus, 50 feet long, and another, Laosaurus, not 10 feet long. There was a monster, however, at Morrison, some hundreds of miles from where the former were found, called Apatosaurus ajax, one of the vertebræ of whose colossal neck was 3½ feet in width, and implies a neck full 5 feet wide. The getting out of this last monster, through the snows of winter, was attended with no little peril to the party. A ledge of rock some hundreds of tons in weight, under which the scientists had been digging, giving way with a crash during the night. Had it fallen in the day time, bones historic would have been added to those primeval. But even these great herbivorous lizards were not without their foes. There were the Allosauridæ, carnivorous dinosaurs, averaging from 20 to 25 feet in length, their feet armed with sharp claws. One of these was called Creosaurus, flesh eater, a cannibal among his kind.

Whilst the Atlantosaurs were a distinct family, they belonged to a sub-order called sauropoda, or lizard-footed. A very perfect skeleton of one of these found by Mr. Williston, in Wyoming, may be taken as typical. Its head was small, showing by the fixed quadrate bone of the jaw and other features a resemblance to crocodiles. The rami of the lower jaw were not united by symphysis. The teeth were numerous, the neck was long, and the vertebræ had deep cavities in them, to lighten them, as in birds of flight. These vertebræ were hollow behind. The humerus bone was massive, and its ends roughened and covered with cartilage. The toes were thick, and had strong, hoof-like claws. This animal, when alive, was full 40 feet long, and walked on all-fours. Its movements were probably sluggish, and it does not seem to have suffered from too deep meditation, as its brain cavity was extraordinarily small—smaller than any known vertebrate not one-tenth of its size.

We next come to a huge reptile, also of Morrison, whose remains are embedded in so hard a matrix of rock, that Prof. O. C. Marsh, who was at work at them for weeks after the party in the field had blasted them in more senses than one, called out a parody on his name in the lines:

> "Break! break! break! at thy cold, grey stones, O. C!
> And I would that my tongue could utter the thoughts that arise in me," etc.

This monster was a nondescript, part dinosaur, part plesiosaur, and part turtle, at least he seemed related to them all. The teeth have compressed crowns and are inserted in sockets. Others of a cylindrical character, more probably spines of the back-bone, are placed in rows of imperfect bone or cartilage. The vertebræ are biconcave. The limb bones indicate an aquatic life. The long body was protected by large, bony plates, like the great turtle Atlantochelys, supported by long spines of the vertebræ. One of these plates was 3 feet long. It

was about 30 feet long, and moved by swimming. It was the mailed warrior of the lakes and ponds.

Such were some of the monsters which enjoyed themselves in olden times around the Rocky Mountains, then islets just peeping above an inland sea. In the marshes and bayous of these islets the Atlantosaurus and other Dinosaurs enjoyed life, sometimes plunging in for a bath, at other times walking boldly on the land and cropping the leaves from the primeval forests. All their friends and foes were reptilian; even the birds were half reptiles and armed with teeth, and the mammals, such as they were, were also allied to the reptiles. All the reptiles laid eggs—and what an egg must Mrs. Atlantosaurus have laid! She is supposed to have been 100 feet long, and, judging from her huge thigh-bone, 9 feet long probably, standing erect, 18 to 25 feet. Truly the Roc's egg, found by Sinbad, must have been the only approximation to it. The climate was warm and uniform, as attested by the fauna and flora of a warm tropical sea, which occupied the western prairies and plains from the Gulf of Mexico over the Wahsatch range. The period closed by a bodily upheaval of the whole western half of the continent, by which the cretaceous sea was drained off, and this, no doubt, caused the death of many of those monsters, though most of them probably died like other creatues, or were mired in the mud which now entombs them in the form of sandstone, uplifted by mountain upheaval, like angry waves surging toward the shore; but, unpoetically known in those regions by the name of *Hogbacks*.

GEOGRAPHICAL NOTES.

THE NORDENSKJÖLD EXPEDITION.

Mr. Nicolas Latkin, who accompanied Nordenskjöld as far as the Lena, has addressed an interesting communication on the expedition to the St. Petersburg *Gazette:* He doubts the veracity of the report that Nordenskjöld has been debarred by the ice near the East Cape from continuing the voyage, because, according to his experience, an open sea generally exists there up to the middle or even the end of November. Should he, nevertheless, have been frozen in on the entrance to Behring's Strait, attempts at reaching him ought to be made from Nischir-Kolymsk or Anardyrsk.

If Nordenskjöld, as is not improbable, has been wrecked at the new Siberian Islands, where he contemplated anchoring for a few days, it would not be difficult to find him, particularly as hunters from Ustjansk or ivory merchants settled at the mouth of the Tudigirka annually visit this archipelago, as well as Tadijeff and the Kotelny Islands, in order to collect the teeth and bones of the antediluvian mammoth. Mr. Latkin affirms that some of the hunters even remain on

those islands the whole year through. Reconnoitering parties could thus be easily organized, especially in winter. The best time for such expeditions, of which those under Mr Sanikoff, a merchant, and Mr. Hedenström, a distinguished scholar, have made themselves famous in the beginning of this century, is the months of February and March, and also the first part of April.

In case Nordensjöld passed the New Siberian Archipelago and wintered on the Wrangel Islands, it will certainly be more difficult but not impossible to establish a communication with him. The Wrangel Islands are, according to the latest Russian maps, situated about three hundred versts to the north of Cape Schilaskoi and two hundred versts from Cape Jakan. A sledge expedition, such as has often been already undertaken and even on a greater scale than now necessary, could be dispatched for the Wrangel Islands if a few hardy, enterprising men were to join it. The most practical time for such an excursion has certainly already passed, but attempts might nevertheless still be made. Mr. Latkin estimates the expenses of a sledge party, either to the New Siberian Archipelago or the Wrangel Islands, at only about twenty thousand rubles. We entirely agree with Mr. Latkin's remarks that, even if such expeditions for the discovery of Nordenksjöld should fail in effect, a small tribute of gratitude for the wondrous achievemen's of the heroic explorer would at any rate have been accorded him.

A telegraph report from Baron Fredericks, the Governor-General of Eastern Siberia, to the Russian Minister of the Interior, in which he gives an account of his endeavor to assist Nordenksjöld in his supposed distress, was received. The dispatch, dated Irkutsk, the 13th (25th) of January, reads as follows:

"On hearing that the *Vega*, with Nordenskjöld and his party, was reported to be frozen up near the East cape, I instructed the Governor of Yakutsk, on the 2d of January, to dispatch from Nishni Kolymsk, or some other suitable place, experienced Tunguses, with reindeer sledges, for the help of the daring Swedish navigator, and at the same time to propagate as fast as possible among the native tribes the intelligence of Nordenskjöld's perilous position. I also ordered him to threaten the severest punishment for any offense or cruelty committed against the needy explorers. The Governor of Frimos likewise received instructions from me to send Tunguses to the Anadyr Bay, and thence to advance on the ice as far as they could. Afraid lest these sledge expeditions, owing to the lateness of the season and the great difficulties to be encountered, might not be in time to give the desired aid, I telegraphically inquired on the 8th of January at the Admiralty whether it would not be advisable to dispatch, on the commencement of spring, one of the vessels stationed at Wladiwostock or belonging to the squadron in the Pacific Ocean, to the Behring Straits in order to search for the *Vega* and rescue her party, who, in all probability, will have abandoned her and forced their way to one of the Tchoutchouk settlements."

Capt. S. R. Franklin, U. S. Navy, in charge of the Hydrographic office at Washington, D. C., has published, for the use of the Navy department, an account of the Nordenskjöld expedition, accompanied by a chart showing the

alterations in the Siberian coast line rendered necessary by Nordenskjöld's surveys. The following extract is of interest in connection with the commercial advantages that are expected by the opening of trade with Siberia:

"78.—Late publications regarding the expedition entertain sanguine expectations of important results in a a commercial way; it is even stated that commerce with the interior of Siberia might thus be opened with the western shores of the United States. A calm review of the narrative of Prof. Nordenskjöld would seem to show that prospects for this are not very encouraging. A comparison of the narrative with the experience of explorers of the Nova Zembla and Kara seas in previous years will make it evident that the *Vega* happened to hit an extraordinarily favorable year. The trade from Northern Europe to the mouths of the Obi and Jenisei may be profitable enough for ventures, but even on that short route it will require the pilotage of the sturdy Norwegian fishermen and seal-hunters, who are acquainted with the ice of these seas during all stages of the short season. A vessel going to the Lena either way would have to be fully provided for the emergency of being embayed for the winter in the Arctic. If, notwithstanding all this, ventures should be entertained, the following notes may prove of interest and value:

The distance from San Francisco to the Lena is, in round numbers, 3,500 miles, of which 1,000 miles may be considered ice navigation—the distance from the mouth of the Lena to Jakutsk, the first place of commercial importance, is about 850 miles. The river is navigable the entire distance and much farther; but, owing to shallows, only for vessels of light draught; cargoes would, therefore, have to be transferred at or not far from the mouth of the Lena.

At Jakutsk the river forms a basin, almost four miles in width, studded with numerous islands.

Entire Siberia has a population of 3,440,000 (0.70 to the square mile), Eastern Siberia, 1,514,758; the province of Jeniseisk, 396,783 (0 39 to the square mile); Jakutsk, 236,067 (0.16 to the square mile); and that of Irkutsk, 358,629 (1.16 to the square mile). The town of Jakutsk, with 4,830 inhabitants (1873), has extensive trade as the depot for Eastern Siberia, and is the seat of one of the factories of the Russian American Company. According to Von Humboldt (*Kosmos*, Vol. IV), it is probably the oldest town on the globe. The Shergin mine near it shows that the ground is frozen to a depth of 300 feet, thawing in midsummer only three feet. The mean temperature for the year is 13.7° F.; in August the thermometer rises for about ten days to 85°, but from November to February it remains between 42° and 68° below zero. The Lena is frozen for nine months in the year.

Irkutsk, about 1,000 miles SW. of Jakutsk, at the confluence of the Irkut and the Angara, near the sources of the Lena, about forty miles from the Great Baikal sea, is, next to Tobolsk, the most important town of Siberia, and the seat of government of Eastern Siberia. It has 32,320 inhabitants (May, 1875), and is the principal depot in Siberia for the Chinese caravan-trade; it has several fine educational institutions, one of them a military academy and navigation school,

an important cloth manufactory, and extensive distilleries. There is great wealth in the larger Siberian towns, and the wealthier classes and the higher Russian officials live in great luxury, which would seem to render trade profitable.

Articles of export to Siberia would be grain, manufactured articles, and colonial products such as sugar, spices, etc.; there might, however, be a sufficient supply of grain from Southwestern Siberia, which is mild and fertile. Articles of import to the United States would be principally mineral ores (graphite) and furs, as also teeth of the ante-diluvian mammoth (fossil ivory), which have been excavated in surprising quantities from the frozen banks of Lena.

P. S.—Since the above was written, it has been stated in some of the newspapers that two sledge expeditions, sent by the Governor of Eastern Siberia for the relief of the *Vega*, could not find a trace of her near the reported position, and that the Russian authorities surmised her to be embayed between the New Siberian Islands, where the channels among the latter and between the southernmost and the mainland are not much over thirty or forty miles wide, and therefore easily blocked by pack-ice.

79.—The westernmost positions reached by vessels from the eastward are: That of U. S. S. *Vincennes*, of U. S. North Pacific Exploring Expedition, under command of Lieutenant, now Rear-Admiral, John Rodgers, U. S. Navy, August 19, 1855, longitude 176° 50′ E., where her progress was barred by packed ice, and that of the whale-ship *Nile*, Long, master, August 11, 1867, longitude 170° 30′ E., where that vessel was also stopped by the ice.

The *Vincennes* made the above longitude in one day from Behring's Strait, but was fourteen days working back against adverse winds."

THE OXUS RETURNED TO ITS BED.

Mr. Edward Campury, in *Le Devoir*, a Guise weekly paper, says that the late news of the changing of the bed of the Amoo is of very great importance to Russia, and he believes that the phenomenon, far from being accidental, has been effected by Russian enterprise.

The Amoo river is the ancient Oxus over which Alexander the Great led his army into Afghanistan, and which at that time emptied into the Caspian Sea, but which, for some two hundred years, has emptied into the Sea of Aral—a lake, properly, for it is about the size of Lake Huron.

Any one who looks at the map of Asia will see that there is no river flowing into the Caspian on the east except a little stream in Northern Persia, and that the great Amoo River receives all the drain of an immense watershed in Western Turkestan.

The Arab writer Mokadassi says that the Amoo once flowed into the Caspian Sea, and that it was displaced by a king of Khiva, who dug a canal to lead some of its waters through the plain of Kharezem into the Aral Sea; that the river

preferring that canal abandoned its own bed from that time. The Khivan dikes turning the river out of its own bed near Kounich-Ougendi are well known to engineers, also the old bed of the river Oxus, which is even indicated on most maps.

Mr. Champury says: "To-day, either by an accident that Russia should thank its stars for, or more likely through a most skillful Russian maneuver, the Amoo has broken the Khivan dikes and taken possession of its ancient bed. The enormous mass of its water now flows toward the Caspian, thus increasing the length of the river more than 500 kilometers" (310 miles). Peter the Great, according to the same writer, dreamed of turning this river back into its ancient bed, and commissioned Prince Bekowich in 1717 to study the measures necessary to effect that result. More recently, and at different times, the abandoned bed has been surveyed by Russian officers. It is, therefore, reasonable to suppose that the late rupture of the Khivan dikes is not merely accidental, especially when we reflect upon its significance to Russia and to the development of civilization in Central Asia. Steam navigation will be possible on the new river, and, if not, the Russians will not long delay in making it so, in order that the rich territory lately annexed from Turkestan may communicate with the Caspian Sea. From this to gaining a navigable opening into the Black Sea, either by the Koor River, in the southern valley of the Caucasus, which river extends about nine-tenths of the way, or not far from 300 miles, or by the way of the Volga and the Don, there is but a step. The Volga, which flows into the northwestern part of the Caspian, almost touches the Don about 200 miles from the mouth of the former—that is to say, thirty or forty miles of canal, and the long-sought Russian port on the Black Sea is a thing accomplished.

The British Association have sanctioned a scheme for the dispatch of an expedition to study the natural history of the island of Socotra. The most important of the vegetable productions of the island appear to be the Socotrine aloes (the finest in the world), the dragon's blood gum and date palm. The terrestrial fauna appears scanty, but the sea swarms with fish, while amber, ambergris and pearls have been exported, and fisheries of the latter are still worked.

The ship "True Love," of Hull, was broken up last year after more than ninety years of active service within the arctic seas.

The possibility of water communication between the Obi and Yenisei seems to be confirmed by late explorers. Baron Aminoff, after having explored the divide between these rivers, reports that the necessary hydraulic works for the construction of a canal with sluices would not present serious difficulties. The canal would be very short, and the marshes at the sources of the Kas and Yazevaya rivers afford a sufficient amount of water.

Two new expeditions to Central Asia are planned in Russia for this spring. The first, by Col. Prjvalsky to Hlassa, in Thibet, and thence to Afghanistan; and the other by M. Blumenfeld, a German savant, who has studied in Russia for botanical and geological explorations.

On January 25th the Geographical Society of Paris held a public reception in the large hall of the Sarbonne, in honor of MM. de Brazza and Ballay, the two French Ogoevi explorers. The great medal for 1879 was delivered on this occasion by Admiral La Ronciére, le Noury, president of the society.

Some members wished this medal given to Nordenskjöld, but the prolongation of his voyage, owing to his detention in Behring's Straits, was considered sufficient reason to postpone his claim until 1880.

Count Wilczek and Lieutenant Weyprecht intend to visit the coast of Nova Zembla in the course of the present year, and will remain there for a year or more, in order to make a series of exact magnetic, electric, hydrographical and meteorological observations. The cost of the expedition will be defrayed by Count Wilczek himself.

The November number of the *Bulletin* of the French Geographical Society contains Dr. Jules Crevaux's account of his exploration in the interior of French Guiana in 1877. Dr. Crevaux, with little assistance, in the face of not a few difficulties, ascended the river Maroni, and, striking the river Yary, traced its course to its junction with the Amazon. The two main results of his journey are the crossing for the first time of the Tumuc-Humac chain at the level of the sources of the Maroni, and the discovery and complete delineation of the Yary, an important affluent of the Amazon. The Maroni he describes as a fine river, of about 140 leagues in length, with a breadth of 1,200 to 1,500 meters at twenty leagues above its mouth, and from 400 to 500 at ninety leagues. The river Yary, Dr. Crevaux considers as more important than the Maroni; it is 150 leagues long, and both rivers are much obstructed by falls and cataracts. Dr. Crevaux gives some very useful notes on the forests of Guiana and the different species of trees which they contain. The highest summits of the Tumuc-Humac range do not exceed 400 meters above sea-level. In summing up his observations on the geology of the region traversed, he says that all the formations met with, from the mouth of the Maroni to that of the Yary, have an ancient physiognomy. They are mainly composed of schistose rocks, which may be divided into three systems, which are in the order of age: 1, the gneiss of the mouth of the Maroni; 2, the schists and mica-schists of the middle course of the river; 3, the ferruginous schists and quartzites of the Maro-Bari and the Yary. These latter are very widespread. All these are frequently traversed by granites and trachytes.

The last number of the *Isvestia* of the Russian Geographical Society contains an interesting paper by Mr. Grigorieff on the temperature and density of water in the Arctic Ocean, along the coast of Russian Lapland and in the White Sea, being the result of observations carefully made on board the schooner Samoyao, by means of good instruments. As to the Arctic Ocean, Mr. Grigorieff confirms the existence of a warm branch of the Gulf Stream which flows along the coast as far as Gavrilovskeize Islands, and thence turns due east to the Kanin Peninsular and Kolgueff Island, and, further, to the Moller Bay on Novaya Zemlya. Beneath this warm current there is a cold one flowing in an opposite direction at some depth. When it meets with a rising bottom; especially with the deep banks of less than 100 fathoms under 71° north latitude, this denser and cold current is compelled to change its direction and make its way between the Gulf Stream and the shore; hence the low temperature and great density of water at the Lapland coast, in the space between Svyatoey Nos and the Seven Islands. The density of the eastern (North Cape) branch of the Gulf Stream (1.025 to 1.026, figures which correspond to a percentage of salt of from 3.28 to 3.41) seems to be smaller than that of the Spitzbergen branch, where Nordenskjöld has found a percentage of salt as high as 3.625. As to the White Sea, Mr. Grigorieff denies the entrance of a branch of the Gulf Stream into that sea, as was supposed some years ago by Prof. Middendorff; the Gulf Stream does not penetrate further than the Gulf of Mezen, and the warm temperatures observed by Middendorff are due to purely local causes. On the contrary, a cold, polar current enters the White Sea along the Tersky coast, whilst the current which flows out of the sea into the ocean, follows the Winter and Kanin coasts. The water of the White Sea, on the whole, has a very low temperature, especially in the deeper parts; on depths more than 100 fathoms the temperature is always below 32° Fahr., and this because of the great loss of heat during the long winter. Altogether, the observations, having been made and computed very carefully, and published *in extenso* in the *Isvestia*, are a real acquisition to science.

THE SUEZ CANAL.

Mr. Farman, United States consul-general at Cairo, Egypt, furnishes the Department of State with an interesting article on the Suez Canal. His facts are derived from authentic sources. A few of them are selected of remarkable interest. The entire cost of the canal was 472,921,799 francs, or $92,273,907. The stock of the company consists of 400,000 shares, at 500 francs each. These shares have sold as low as 100 francs each. At the opening of the canal they had advanced to only 300 francs. They are now quoted at 717 francs, and are probably worth more. The British government paid about 568 francs. The number of shares bought, in 1875, by Lord Beaconsfield at this price was 176,602. This great purchase, aside from its political and commercial advantages, thus affords a clear profit of 25,000,000 francs at present prices. The balance of the stock is held by a large number of persons, mostly in France. The revenues of the canal

have increased from 5,000,000 francs in 1870 to over 30,000,000 francs in 1877. The expenses, including interest, sinking fund and lands, have been a little over 17,000,000 francs per year. While the revenues steadily increase, the expenses are decreasing or stationary. Deducting the amount paid for interest and the sinking fund, the actual expenses are about 5,000,000 francs annually. The cost of cleaning the canal and its accessories is only about 2,000,000 francs per annum. The small comparative cost of maintaining the canal arises from the fact that there are no locks or lateral embankments to be broken. Except the ordinary cleaning, there is little to be done. Vessels drawing twenty-five feet of water or less pass through the canal. The saving of distance to the British ships going to India is nearly 5,000 miles. Two-thirds of all the vessels passing through the canal carry the English flag.

Monsieur Ferdinand Lesseps, who has been at the head of the enterprise since its beginning in 1854, expresses the opinion that the Panama canal must be constructed without locks to be successful or remunerative.

AFRICAN EXPLORATIONS.

Mr. Cuthbert B. Jones, United States consul at Tripoli, in his dispatch to the Department of State, dated January 22, 1879, announces that on December 27, 1878, Dr. Roehfs, accompanied by Dr. Stecker and Baron Coillagh, left Tripoli to explore a portion of Africa hitherto unknown to the world, the southern part of the Stadai country. Dr. Roehfs, when in Tripoli in 1866, contracted the Mussulman belief. He is now a Christian, which may somewhat embarrass his enterprise. He is one of the most successful African explorers, having made several difficult voyages into the interior.

NOTES ON POLAR EXPLORATION.

BY CAPT. H. W. HOWGATE, U. S. A.

The following notes, collated from a recent English work, show the feeling abroad upon the subject of Polar Exploration as contemplated in the bill now before Congress to authorize and equip an expedition to the arctic seas.

The United States has naturally, from its geographical position, a greater interest in the solution of the polar problem than any other nation, and reasons sufficiently strong to induce the British Government to fit out a costly expedition should have weight with our own in considering the proposition to send out a comparatively inexpensive one, that promises valuable practical as well as scientific results.

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The complete exploration of the unknown area surrounding the Pole must be achieved by a Government expedition, because thorough preparation and equipment are essential, and because, in the case of large bodies of men passing

through an arctic winter, naval discipline and *esprit de corps* are absolutely necessary. The enterprise, though feasible and devoid of undue risks, is one of vast proportions

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There is an abundance of excellent animal food up Smith Sound; the climate is exceptionally healthy, and, though the officers and men will be exposed to individual dangers and privations which will test their high qualities to the utmost, there is no more chance of a disaster to the whole expedition, and far less danger of sickness, than on any other station frequented by the ships of our navy.

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No work can be conceived more important to science, more useful to our navy, and more worthy of being undertaken by our Government.

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"*He is not worthy to live at all who, for fear and danger of death, shunneth his country's service and his own honor, since death is inevitable, and the fame of virtue immortal.*"—SIR HUMPHREY GILBERT.

* * * * * * *

"The navy," said Admiral Sherard Osborne, in 1865, "needs some action to wake it up from the sloth of routine, and save it from the canker of prolonged peace. It cries not for mere war to gratify its desire for honorable employment or fame. There are other achievements as glorious as a victorious battle; and a wise ruler and a wise people will be careful to satisfy a craving which is the life-blood of a profession."

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One of the most distinguished medical officers who has served in the arctic regions (Dr. J. J. L. Donnet, Deputy Inspector of Hospitals and Fleets in the British Service) is convinced that, of all seas visited by men-of-war, the Arctic have proved the most healthy. In every sea casualties will occur, but in the Arctic those which have been noted during the last quarter of a century have been few and far between, and they have risen chiefly from frost-bites, from which one death alone is recorded. Of those diseases which swell the bills of mortality in England, especially of that class termed zymotic, which includes typhus, typhoid, small-pox, etc., none are recorded.

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If the solution of the greatest geographical problem that remains to be solved, and the attainment of numerous important scientific results, are not considered worth the expenditure of the trifling sum required, an expenditure which will be richly and abundantly repaid, the character of the English-speaking people must have strangely altered with the present generation. No such extent of unknown area as that which surrounds the North Pole ever failed to yield results of practical as well as of purely scientific value; and it may be safely urged that, as the area certainly exists, its examination cannot fail to add largely to the sum of human knowledge.

* * * * * * * * *

Professor Newton, of Cambridge, has drawn attention to some interesting

questions relating to the migrations of birds toward the unknown area. He says: "The shores of the British Islands, and of many other countries in the northern hemisphere, are annually, for a longer or shorter period, frequented by a countless multitude of birds which, there is every reason to believe, resort in summer to very high northern latitudes for purposes the most important, and, since they continue the practice year after year, they must find the migration conducive to their advantage. There must be some water that is not always frozen; secondly, there must be some land on which they may set their feet; and, thirdly, there must be plenty of food, supplied either by the water or by land, or both, for their nourishment and that of their progeny.

"People who have been in Iceland and Greenland have noted the appearance of these birds in those countries, but in neither of them do they stay longer than with us; and, as we know that it takes no other direction, it must move farther north. We may, therefore, fairly infer that the lands visited by these birds in the middle of summer are less sterile than Iceland and Greenland, or they would hardly pass over those countries. The supply of food must depend chiefly upon the climate. The inference necessarily is that beyond the northern tracts already explored there is a region which enjoys in summer a climate more genial than they possess."

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The unknown results of exploration must have due weight. Judging from analogy, we may be sure that many of the discoveries of the polar explorers will be unforeseen and unexpected. The learned president of the American Geographical Society, in June, 1871, well said that we do not know and cannot estimate in anticipation the consequences that will result from more accurate knowledge of our globe, and that Columbus found very few who would sympathise with him or who perceived the utility of the effort on his part to go out into the unknown waste of waters beyond the Straits of Gibraltar in search of a new country. Who can at this time estimate the advantages which have followed upon that adventure? If now it should be possible to reach the Pole, and to make accurate observation at that point, from the relation which the earth bears to the sun and to the whole stellar universe, the most useful results are very likely to follow in a more thorough knowledge of our own globe.

Referring to the bill (H. R. 447) to authorize and equip an expedition to the arctic aeas, I have the honor to submit that, aside from any benefits that may accrue to science from a thorough exploration of the vast area within the Arctic circle yet unknown to civilized man, the present reduced condition of the whaling interests of our country would alone justify the expenditure of ten times the cost of the proposed colony on the shore of Lady Franklin's Bay as a reasonable effort to discover and develop new whaling-grounds.

It may be that there is no large body of water—no "open Polar Sea"—within this unknown area, but it is the opinion of some of the most distinguished geographers and experienced explorers that one does exist, and that it abounds in such forms of life as are found in more southern waters.

Prof. Maury, the distinguished scientist, says "within this Polar area *the whales have their nursery.*" Prof. Agassiz, another distinguished scientist, of whom New England is justly proud, writing to the president of the American Geographical Society in favor of a polar expedition then before the public, says: "I consider it as highly important, not only in a scientific point of view, but *particularly so for the interests of the whale fisheries. The discovery of a passage into the open water around the Pole, which would render whale fishing possible, would be one of the most important results for the improvement of whale fishing.*"

The following figures, taken from Mr. Starbuck's exhaustive history of the whale fisheries of the United States, show the startling decadence of this important branch of national industry and the necessity of prompt action to prevent its total extinction:

In 1846 there belonged to the various ports of the United States 647 ships and barks, 35 brigs and 22 schooners, with an aggregate capacity of 233,189 tons.

On the 1st of January, 1877, the entire fleet was reduced to 112 ships and barks, and 51 brigs and schooners, having a total capacity of 37,828 tons.

The value of bone and oil brought into the United States in 1854 amounted to $10,802,594.20, and in 1876 to only $2,639,463,31.

While I believe that the interests of geographical and scientific discovery as set forth by Profs. Henry, Loomis, and others, in connection with the proposed Arctic Colony, are of themselves of sufficient magnitude to warrant favorable legislation, the additional practical and commercial results that are possible would seem to demand such legislation as a matter of justice to that section of the country whose inhabitants depend so largely for their employment upon our whale fisheries as those of the New England states.

The following statement in reference to the cost of the proposed Polar Colony on the shores of Lady Franklin Bay, as provided for in Senate bill 438 and House bill 447, respectively, is respectfully submitted for consideration:

1. *The Vessel.*—This is to be used simply to transport the colonists and their supplies from the United States to their destination, returning as soon as this is accomplished. Any small vessel now in commission will answer this purpose, and need not be occupied more than three months in the year at the most.

The vessel, with her officers and crew, being already in service and maintained by stated appropriations, the only additional expense required for the purpose would be that incurred in strengthening it for service in the ice. This cost would probably not exceed $5,000, as my small vessel, the "Florence," which passed the winter of 1877–8 in the arctic, was strengthened for one-tenth of this sum.

The Colonists.—The colonists are to be detailed from men now in the army and navy, and would receive the same pay and allowances as when on duty elsewhere.

There would be no increase in the present number of men in either service, and no additional cost to the United States beyond that of the few articles of pro-

vision and clothing especially required for arctic work. These provisions would probably cost for the three years $17,500, and the clothing $2,500 more, or $20,000 in all. There is now ready for the use of the expedition a large quantity of fur clothing, collected by the "Florence" expedition of last year.

The Scientific Corps.—The members of the scientific corps, like the colonists, would be detailed from the several arms of the service, and, in like manner, would entail no more expense to the United States than when on duty elsewhere. Astronomers, meteorologists, naturalists, physicians and specialists in the most important branches of science, are to be found in the service of the Government, who would willingly volunteer for the duty, and could be temporarily spared from their present labors without detriment to the United States.

The balance of the appropriation asked would be required for the purchase of special instruments and apparatus, of buildings for the shelter of the colonists, for balloons and sledge outfits, etc., and would be ample for a three years' supply.

The Florence, a small sailing vessel, fresh from a winter in the arctic, and completely fitted for another voyage, will be placed at the disposal of the expedition as a tender, without charge to the United States.

The various items of cost have been gone over carefully by men of experience in the kind of work proposed, and their accuracy verified by comparison with former expeditions and by my own recent personal experience.

If the bill passes as drawn, I have no hesitation in saying that the sum appropriated will be sufficient to carry out the purpose of the expedition in a manner that will reflect credit, not only upon the men personally engaged it, but upon the nation, to which foreign nations are now looking for a solution of the polar mystery.

PHYSICS AND METEOROLOGY.

PROBABLE CAUSES OF ARCTIC HEAT IN FORMER TIMES.

BY EX.

A theory to account for the former high temperatures that existed in the Northern Temperate and Arctic regions. On the necessarily different conditions that existed in the diurnal phenomena; the relation between latitude and temperature, etc., etc.

PROP. 1. The development of vast coal formations after the silurian period was undoubtedly caused by the deposit in place of an enormous aggregate of vegetable growth, fostered by circumstances and by conditions not now existing, and a development of terrestrial temperature now unknown in high latitudes.

2. That we may have good reason to believe that at the period when the coal-fields of the devonian and carboniferous periods, and down to the tertiary

age even, were formed, abnormal causes contributed to produce a peculiar rapidity and profusion of growth now unknown; that this was mainly due to excessive conditions of heat and moisture, aided, perhaps, by an excess of carbon, also seems generally reasonable and satisfactory, but yet does not account for the higher temperature that existed from the 37° north latitude to, well into the Arctic regions, for a period, we may say, to the end of the miocene period.

3. That all that is claimed for, or in explanation of, the vast accumulation of coal formed in the carboniferous age can as justly be claimed for the coal formations of the cretaceous and tertiary periods in the New World, which, in area, even exceed all the so-called "true coal measures" of Europe, Asia and America combined.

4. That, to account to-day for the high temperature that once prevailed even as far north as the Melville Islands in the Arctic regions, we believe the following hypothesis might explain what has hitherto been an unexplained problem, which hypothesis we propose to develop and consider. And we will here say that we firmly believe that the anomalies of latitude, temperature and the seasons, now prevalent from the equator to the pole, did not then exist in the devonian, the carboniferous and to the end of the cretaceous and tertiary ages; and, using Dr. Candolle's terms, the growth of "megathermous" and "mesothermous" vegetation in those geological periods was caused by a totally different condition of temperature and the seasons.

5. That at a period of time (we might say the devonian age) we may suppose that the motion of the earth in space was the same as now, with the sun as the central point of the solar system, but that a source of attraction then existed, situated in the vast stellar space outside of the earth's orbit around the sun and at an immense distance from the earth, this attraction being powerful enough to arrest or modify the motion of the earth on its axis.

6. That in the earth's yearly revolution around the sun this source of attraction kept the earth's longest axis (that of the equatorial ellipse) constantly parallel to this line of attraction in stellar space.

7. That, as a consequence of this modified or destroyed axial motion of the earth, the alternations of day and night, and of the seasons, and consequently the diurnal temperatures of the long days and long nights, were totally different from present conditions.

8. That, as a consequence of the lengthened period of time that the heat and light of the sun were continued in high latitudes at either pole, the long twilight, the prodigiously longer days at either pole, the long periods of moonlight, joined to excessive evaporation of water from the large areas of seas and lakes that then exceeded our present water surfaces, must have been singularly favorable for tree and plant growth, and made the flora of high latitudes profuse and almost unlimited in their season. We would thus easily conceive that the Arctic Continent could readily support a growth of trees of magnificent foliage and size. We can even think, with the present knowledge we have, that in the carboniferous age the anomalies of temperature and the different seasons, the whole "*tout*

ensemble" of diurnal phemomena, were then at their maximum; that in the cretaceous age they were already much modified, for between these two radical periods of geological successions we find very conclusive and precise indications of a successive adaptation of the organic world to strongly modified conditions of the earth's surface.

9. That this condition of the earth was not in the carboniferous period favorable to the existence of terrestrial vertebrates, or birds and insects, but eminently fitted for saurians, fishes and mollusca, and that generally, from the knowledge we have of the animal life that existed, no very serious or wide-spread changes in animal creation took place within the cretaceous period.

10. That while these conditions previously enumerated prevailed, the influences of heat, cold, light, air, water, wind, tides, and all meteorological phenomena generally, were much modified; sub-aerial denudations and the dynamical effects of the elements were different in amount and results.

Geologists have been for over 100 years working on the intricate problems of their science, approximated for the successive ages and periods from the archæan up to the post tertiary, the relative areas of water and dry land that existed in the several periods. If we collate these with the assumption of a globe at first without axial motion, or our present diurnal change, and then this motion successively modified and increased until the tertiary period, we think many geognostic problems might be solved. If we take the tide, for example, whose effect is continuous, irresistible and ever-active, yet we know its power must finally very materially affect the earth's motion, retarding it slowly year by year. Certainly we may not be able to say now how much precisely it does do so for the short period known of human science, yet, as it had once a beginning, so must it necessarily end, or be much modified when the earth's axial motion is finally arrested by it, and the attractive and repelling forces altered by this changed motion.

11. That the hypothesis of a former change in the length of our present day, which is measured by one rotation of the earth on its axis, in no manner disagrees with the Mosaic account of creation. For if we cannot agree upon the occult meaning of his chronology in precise years of time, from the day-dawn of earth, yet this in no manner attacks the truth of his testimony if we can geologically define the period that elapsed before the six days of creation.

12. That the variation of the motion of the earth in the ecliptic, its varying inclination, the eccentricity of its orbit, the effect of the precession of the equinoxes, and the changes which every 12,900 and 25,800 years, as it has been claimed by some scientists, take place from the above causes—changing alternately in the northern and southern hemispheres the length of summer and winter—cannot in amount be great enough to account for the former high temperatures existing in the Artic regions from the carboniferous to the miocene, tertiary period. If we to-day count our summer from the March solstice to the September solstice, we have 186 days of sun for the northern hemisphere, against 179 days for the southern hemisphere, thus making the southern hemisphere a little colder. But it has been shown that, taking the very highest estimate possible, the difference of

seasons that all the above variations of the position of the earth can take would cause a difference of season between the two hemispheres not exceeding thirty-six days in all, and would alternately affect both in the same ratio. This certainly could not be sufficient to transform Greenland and the Melville Islands into a climate like that of Florida or Louisiana to-day.

13. The vegetation of the carboniferous age was rank, dense and peculiar; probably agreeing with De Candolle's mesothermous type; requiring at least a mean temperature of 66°. This, with abundant moisture, frequent rains, long days and warm nights, would give us the most favorable conditions for the growth of calamites, sigillarias, lepidodendrons, floras and equisetaceæ so abundant in the carboniferous period.

14. Following this period, and until we reach the cretaceous period, we find but a scanty list of plants and trees in the permian, triassic and jurassic; the area of water on this globe was largely in excess of land surface. In the cretaceous we find this proportion has decreased some, and that in the Dakota Group, so well elaborated by Prof. Lesquereux in his flora of that group, we find the ancestors of our present forests of oaks, plane trees, magnolias, cedars, yews, sassafras, laurel, poplars, sweet-gums, etc., that indicate a growth of trees peculiar to our temperate latitudes south of 38° north latitude, indicating generally a temperature of an isotherm of about 60°.

15. That this order of climatic and terrestrial changes extended until late in the tertiary period. We might state it, perhaps, as lasting until the end of the miocene, which in Greenland to-day shows a fossil vegetation rich in oaks, cedars, magnolias, palms, figs, etc. That after this period the revolutions of the earth on its axis increased rapidly, the seasons, the length of day and night became more and more pronounced and shortened, cold invaded the more temperate circumpolar lands, the vegetation of high latitudes then either perished or slowly retrograded south and north from their respective polar regions toward the equator.

CONNECTION BETWEEN THE DAILY FLUCTUATIONS OF THE BAROMETER AND OF THE MAGNETIC NEEDLE.*

BY PROF. JOHN D. PARKER.

At a recent meeting of the Academy of Science, Prof. J. M. Greenwood asked the following question: "Is there any connection between the daily maxima and minima of the barometer, and the diurnal fluctuations of the magnetic needle?" Let us consider this question in the light of general principles.

First, what causes the daily maxima and minima of the barometer? It is a familiar truth that a column of mercury, at the level of the sea, about thirty inches in height, weighs the same as a column of air of the same base extending to the top of the atmosphere. In an atmosphere *in equilibrio* in temperature, all

*Abstract of a paper presented at the February meeting of the Kansas City Academy of Science.

its columns from base to extreme surface would be of the same height and weight. If a column of air be heated it will expand and flow over the neighboring columns, or lose its weight; but if a column be cooled it will contract, and the neighboring columns will flow into it and increase its weight. If the barometer falls in a country it is because the temperature of that country is higher than that of neighboring countries, whether heated directly, or those regions have cooled. If the barometer should rise in a country it proves that this country has become colder than those regions that surround it. As a region becomes heated, we should expect that the barometer would fall there and *vice versa*. Rain, according to these principles, is only an effect produced by the conditions of the atmosphere which the barometer detects. When a region of the earth is heated, the weight of the atmosphere becomes less, and the vapors gradually settle toward the earth, and are precipitated in rain.

In accordance with these principles a maximum of the barometer should occur at midsummer, while two opposite daily crises should occur at the hours of greatest heat and greatest cold. Observation proves a general correspondence with these laws with some anomalies. The atmosphere proper contains a small amount of vapor which may be termed the vaporous atmosphere. The increase of the solar heat due to the season, or hour of day, augments the amount and weight of this vaporous atmosphere. Its relation to the barometer is, therefore, inverse of that of the atmosphere proper, or the permanently elastic fluid. Out of this contradiction all the anomalies spring. If we separate these two atmospheres, and note simply the effects of the permanently elastic envelope, we find the heights of the barometer are inverse the heights of the thermometer.

Combine these two atmospheres and we have three barometric curves, only two of which need now be considered. From the maximum height of midwinter the pressure diminishes until the vernal equinox, because the dry air expands, diminishing its weight, without a corresponding increase in the amount of vapor. From the vernal equinox the pressure increases during the summer months, because the rapidly increasing vapor more than compensates for the diminution of the weight of the dry air. From the autumnal equinox the total pressure diminishes, the aqueous atmosphere precipitates rapidly, while the weight of the dry air augments slowly, after which the barometric curve ascends gradually until the barometer attains its winter or absolute maximum.

We are prepared now, in the light of these general principles, to understand the daily maxima and minima of the barometer, or the diurnal curve. Take out the effect of the vaporous atmosphere, and we reduce the barometer to a single diurnal curve — a maximum at the hour of greatest cold, and minimum at the hour of greatest heat. Combine the two atmospheres, and we have two maxima and two minima, in general as follows:

Minimum of morning, 3 hours and 45 minutes a. m.
Maximum " 9 hours and 37 minutes a. m.
Minimum of evening, 4 hours and 5 minutes p. m.
Maximum " 10 hours and 11 minutes p. m.

During winter these hours are nearer midday by a difference, sometimes of nearly two hours. The diurnal curve, of course, is greatest at the equator where we find the most vapor, and diminishes toward the poles. We find, therefore, that the daily maxima and minima of the barometer is due to the solar heat operating upon the two atmospheres that constitute the total envelope of the earth.

Secondly, let us consider if the daily fluctuations of the magnetic needle can be traced to the same general cause. We can see this part of our subject also better in the light of general principles. A steel bar magnetized, and freely suspended from its center of gravity, does not coincide with the geographical meridian, but deviates by an angle termed magnetic declination. The line along which the needle lies is called the magnetic meridian. The needle has also a tendency to dip as we approach the magnetic poles. The illustrious Humboldt induced the Russian and British governments to establish magnetic observatories in various places, so that maps (like these charts) of the magnetic meridians have been constructed.

Now, if you take a wire and pass a current of electricity through it, you find the magnetic needle will, when brought near it, take a position at right angles to the wire. It has been found that the solar heat induces currents of electricity in the earth which pass around it from east to west. The immense quantity of vapor abstracted from the ocean in the equatorial regions also conveys electricity with it toward both poles, which is discharged more copiously at certain seasons, causing the Aurora Borealis and the Aurora Australis. These currents, in returning toward the equator, probably combine with the currents of electricity passing around the earth from east to west, and cause the needle to deviate, destroying the coincidence of the geographical and magnetic meridians.

We are now better prepared to understand the daily fluctuations of the magnetic needle. The pole of the needle least distant from the sun makes a double diurnal excursion. It is at its western maximum from four to five hours before the sun crosses the meridian of the place, then moves eastward reaching its eastern limit one or two hours after the sun passes the meridian, and repeats this variation, within less extended limits, as the sun passes the inferior meridian

Thus we see that the daily maxima and minima of the barometer occur at nearly the same hours as the diurnal fluctuations of the needle. The daily excursions of the needle are doubtless due to the variations induced in the electrical currents by the increase of the solar heat, which, also operating through the two atmospheres composing the total envelope of the earth, causes diurnal fluctuations of the barometer. Both fluctuations are probably due to the same cause, the solar heat, which, however, operates in different ways and through different media. This is sometimes termed the thermo-electrical theory, and may be accepted until a better one is discovered.

Prof. Greenwood asked the author of the paper, if he thought heat produced electricity. Prof. Parker replied that heat does not produce electricity as an acorn produces an oak; but a disturbance of the thermal conditions produces a disturbance of the electrical conditions. As illustrations of this principle, a lamp

will cause a current of electricity to flow along a wire, and a very hot day is sometimes followed by a thunder-shower, or more often by what is known as heat-lightning.

CORRESPONDENCE.

RECENT FACTS FROM COLORADO.

BY J. K. HALLOWELL.

EDITOR KANSAS CITY REVIEW OF SCIENCE:

Dear Sir—Under the present excitement of the public mind regarding this State, and especially the portion drained by the head-waters of the Arkansas river, anything written for publication should be as near to known facts as possible, with most of the hearsay left out; as, on carefully "panning" the latter, it will not always show "color." But "where there is so much smoke there must be some fire," and, thinking as much, I concluded to come and see for myself, to learn the country practically, and, if possible, to also give what I might learn as facts in as plain and simple a manner as possible to those who might be interested enough to read.

The first effort that I made was the attempt to divest my mind of all preconceived notions of the country, and particularly of the idea that Leadville was the only place to go to, especially under the present excitement that is working in that direction, as it cannot help but be a fact that the future profits of the coming immigration have already been largely discounted at that particular place. If the reader will pause to consult a good map or the geological sections given in Prof. Hayden's reports to the Government of this region, he will see that the mountain region of the Arkansas river is about one hundred and fifty miles long by sixty wide, with almost the same formations on each side; that Leadville and Oro City, in California Gulch, are at the extreme northeastern corner of this mountainous tract, while the Rosita mining district is nearly at the southwest corner, and looking down into the beautiful Wet Mountain valley, which I am told is one of the garden spots of Colorado.

With these two rich mineral districts at each extreme, would not the proper deduction be that in the whole intermediate country the probabilities are that just as rich spots are to be found? It cannot be otherwise when we take into consideration that the tract contains innumerable mountains and gulches, all of which as far as explored show to the prospector many evidences of concealed mineral wealth. Following this line of reasoning, are not the chances of the prospector, the miner and the capitalist much better outside the points where the most intense excitement is—the one to obtain an individual competence the sooner, the other to secure the most valuable property for the smallest outlay of cash? While, on the other hand, the merchant and speculator will naturally gravitate to the point

where the greatest rush is for the time being, only to pull up stakes for another place when a new discovery brings it into popular favor. From present indications I foresee that the speculator will be kept moving in this country pretty lively for the next five years, as such an era of mining excitement has set in that I can liken it to nothing as a comparison except the "oil fever" of fourteen or fifteen years ago. There is this difference though: the property will be divided among a large number of owners, and not allow the same opportunity for monopolies.

The next query is how to get there. The competing railroads are perfectly capable of tooting their own horns, and will probably reap as great a harvest as any one, which is right; as to the energy of the managers of those corporations we owe the present rapid development of this country; and let those who do not believe in those corporations as means of good either stay at home, or, if they must come, this is still a free country, and there is one privilege no "grinding monopoly" can take from them—they can walk.

Many purchase tickets at Kansas City via the Atchison, Topeka & Santa Fe Railroad to Denver. Coming to Pueblo, Colorado, and, concluding not to go to the mountains from Denver, they dispose of the balance of their railroad ticket and come up to Cañon City instead, and from there get to the nearest mining camp; or, if they wish to penetrate farther, the means of transportation are quite as good (and growing better) as from any other point. Traveling by way of this route, one will see the best of the State of Kansas in an east and west line. You leave Kansas City at 10:45 a. m., and in twenty-six hours you are at the Pueblo depot. You will dine at Topeka, sup at Florence and breakfast at Lakin. After passing Newton, Kansas, you soon enter the Arkansas valley, and such easy railroad riding I never had; the rails seemed as if laid on a floor, so smoothly did the train roll over them. Soon after passing Las Animas, Colorado, you will come in sight of the mountains, the Spanish Peaks to the south, and, by the time you have taken in their snow-clad summits, behold Pike's Peak in all its glory looms up to the northward. To one unaccustomed to such grand natural guide-posts it seems as if he could not watch them close enough; so varied are the changes that come over them of sunshine, cloud, snow and ever-changing distance, that he feels as if, in looking from a car-window, it was a grand kaleidoscope of Dame Nature that he was peeping into.

The sorriest sight of the whole ride was the many dead cattle we saw. They lay where they fell on the plain, in the gullies, and by the river-side, starved to death, the effects of this unusually severe winter and heavy snows.

As you approach your journey's end the river valley narrows, the foot hills become closer, until finally your train rushes into a deep cut in a kind of irregularly bedded soapstone rock overlaid with many feet of gravel, to emerge at the other end into a huge natural gravel pit. Herein is the place that Pueblo is built.

Desiring to commence at the beginning, and pass nothing by from which I might learn, I stopped here twenty-four hours. I found the mesa or table-land that surrounds Pueblo on the west, north and east but a huge gravel deposit,

XUM

out of which the Arkansas river has scooped a nice, sunny basin, opening to the south, and in this basin the town is laid out. The population is about 5,500, and while I was there I could not get rid of the impression that it was Sunday, so quiet did it seem. On inquiry the fact was revealed that one-half the population was at Leadville at present, and the other half sorry that they could not go. The town is garnished with a well-built court-house and school-houses, and is furnished with water-works—the Holly system—while the fine brick residences on the surrounding mesa add materially to its substantial appearance. The place of most interest to me was the silver reduction-works of Messrs. Mather & Geist, situated quite near to the railroad cut spoken of before. The chimney of the works is built on top of a hill, and the building containing the furnaces near the bottom; a long flue running up the hill-side connects the two, and the distance is such that most of the vaporized precious metal is deposited and saved within it, while otherwise it would be lost. There are three furnaces, capable of reducing seventy-five tons of ore per twenty-four hours, each furnace running from eight to ten weeks before choking up; this is owing to the suitable character of the flues used and the care taken in keeping up an even temperature. Each furnace is square in shape, with two openings for running off the slag, and two more smaller through which the metal is continually emerging into a small pot built into the brick-work, and from there ladled into iron moulds containing about 150 pounds each, and shaped very much like bars of pig-iron. In this condition it is called base-bullion, and is ready for shipment East, where it can be still further reduced more economically. The slag is drawn off into large, iron pots mounted on wheels, and when cool enough is wheeled into the yard, dumped and broken up, quite a large button of metal settling at the bottom, which is saved to go again through the furnaces. The coke comes from Trinidad, Col.; the iron ore flux, from Garland; while the limestone used is obtained about four miles up the river, where it is loaded direct on the cars from the quarry, the Narrow Gauge road having a switch-track to the works, as does also the Atchison, Topeka & Santa Fe Railroad, standard gauge, making railroad communication with the whole country. I was somewhat surprised to learn that Cañon City coals would not coke, while those from the north contain too much sulphur to be as good for smelting purposes as the coke obtained from Trinidad. The ores used are shipped from Rosita, Col., and Leadville, consisting of argentiferous galena from the "Ben Franklin" mines, some carbonates from the "Bassick" of the first place, and all carbonates from the latter. The Rosita ores are hauled to the works in wagons; the Leadville ores are hauled to Alamosa, Cañon City and Colorado Springs, and from there shipped by rail. Of the Leadville carbonate—well, I have seen many clay-banks that looked as rich although there is a perceptible difference in the specific gravity; in color they resemble the clay-banks of Kansas City, while the "Bassick" ore was a light yellow and much richer in "pay." The ores are shipped in sacks weighing from seventy to one hundred and fifty pounds. Some is received in bulk from Leadville at present, the quantity taken out being greater than can be properly packed; to this

there must be some waste in the long haul by wagons, and where, of course, a saving will be effected in time.

It is a real pleasure to visit works conducted as these are. Although many men are employed, there is no confusion or noise. Each man appears to understand his duty and does it. The proprietors give personal supervision to every thing, and as I watched the men carrying sacks of ore into the building, previous to weighing, I heard the manager cautioning the men to be careful in handling some sacks in which small holes were worn, that no ore might be wasted. It is such close and careful attention to the interests of their customers as this that is giving these works an enviable reputation among mine owners; for, as near as I could understand it, the smelting-furnace stands in the same relation to the miner that the grist-mill does to the farmer, and is conducted on much the same basis. As the ore is received after weighing, an average assay is made; a deduction of ten per cent made for loss, or difference between assay returns and actual working product. A charge of thirty dollars per ton is made for reducing, and the balance paid the shipper at once, the price being based on the price of silver per ounce on that day.

From here I go to Rosita, via Cañon City, where the mines are the most developed of any in this part of Colorado. There I hope to learn of some practical facts in actual mining that I trust will be of interest at a future time to the readers of this Magazine.

THE COLDEST DAY IN MANY YEARS.

EDITOR KANSAS CITY REVIEW OF SCIENCE:

Dear Sir—Being satisfied, from a personal acquaintance with you, that your object in the publication of the REVIEW is to present facts in all cases and on all scientific subjects where they are to be obtained, I herewith offer a correction, or rather an amendment, to an article published by you in the January number, whereiu you gave a list of the coldest days in Kansas City during the past twelve years. You omitted the 29th of January, 1873, which was undoubtedly the coldest day we have experienced within the memory of the gentleman so often referred to in such cases, "the oldest inhabitant." Upon that morning the thermometer at my office at the Kansas Stock Yards indicated 34 degrees below zero at 7 a. m., and one at my home on O. K. creek, south of the city, was not spaced and marked lower than 32 degrees below zero, but at 6:30 a. m. the mercury was *below that point*, and only rose to it after the instrument was taken into the house, (under the impression that it was broken.) I well remember of hearing, during the day, of other thermometers indicating from 30 to 38 degrees below zero, one in particular being at the Kaw Valley Hotel, where the mercury stood at 36 degrees below zero early in the morning. All passenger and stock trains were delayed, owing to the engines being unable

XUM

to work their pumps. I have referred to the files of the *Daily Journal* on the subject, and in its issue of January 30th I find the following notes:

"At Wyandotte the thermometer fell to 32 degrees below zero, and in some exposed places as low as 40 degrees." * * * * * * *

"At Armstrong the thermometer at 6:30 a. m. yesterday was 37 below zero, and at 12 m. 28 below; hardly a person could be seen out, and it was only with the greatest difficulty that the engines belonging to the K. P. R. R. could be kept moving." "In Kansas City, Kansas, the thermometer at 6 a. m. fell to 38 degrees below zero, and in some places the mercury froze, so that it was impossible to tell the exact temperature." * * * * * * *

"At the residence of Mr. Jones, on Delaware and Sixteenth streets, yesterday morning at 5 o'clock the thermometer indicated 27 degrees below zero."

Thus the records of the day bear me out even stronger than I require in statements I have made in conversations on the "cold snaps," statements that have been denied as being too improbable for belief.

Respectfully yours, H. P. CHILD.

Kansas City, March 5, 1879.

ASTRONOMY.

THE GREAT PYRAMID IN CONNECTION WITH THE PLEIADES;

OR, THE LAST ANNIVERSARY OF THE GREAT YEAR OF THE PLEIADES. WHEN, HOW, AND WHY CELEBRATED.

BY REV. JAMES FRENCH, DENVER, COLORADO.

The time during which the fixed stars make one revolution is called a Great Year. This period begins with the right ascension of a sign of the Zodiac, and ends when this sign has completed its 360 degrees. It takes 25,827 solar years to make one Great Year. The Pleiades are a beautiful cluster of stars, and the most conspicuous group in the sign or constellation Taurus. Its principal star, Alcyone, was on the meridian a little north of the celestial equator, in the zodiacal belt, at 0 hour, right ascension, at midnight of the vernal equinox, B. C. 2170 years, and marked that date as the beginning of a Grand Cycle. This is called the "Great Year of the Pleiades," in honor of the unique group of stars which keep the record of its age.

Coincidently with the beginning of this Great Year another star, Thuban (the Dragon,) was on the same meridian, near the North Pole, distant from it 3° 42′. Here was one conspicuous star exactly south, making sidereal time, and another conspicuous star exactly north at the same time, so that straight rods pointing to each would indicate north and south more exactly than the needle of the compass. If these rods were fixed as pointers to the north and south, they would aim like

guns to their respective north and south stars once every night. This exceedingly rare coincidence in star-pointings occurred at the epoch of the Great Pyramid and on the anniversary of the Great Year of the Pleiades. Its star-pointings symbolized that date and no other.

That there is nothing fanciful in this theory of accounting for the design of the Pyramid's erection, we show by referring to scientific authority of a high order. Sir John Herschel, a distinguished astronomer and the son of a distinguished astronomer, noticed the peculiar entrance to the main avenue of the Great Pyramid, fifty feet up from the base, so high and difficult to reach as to make the entrance extremely inconvenient, and he wrestled with the query, Why an entrance so inaccessible? His cultivated genius soon furnished the correct answer to his question. He discovered that the angle of declination in that avenue pointed exactly 3° 42′ below the Pole, which was precisely the spot where the North Star Thuban would be seen when on its meridian, at its lowest culmination, when the Pleiades were on the same meridian south and just commencing the round of a Great Sidereal Year; and the design of erecting such a structure, at such a peculiar point of time, seemed to him "to *memorialize*, or, farther still, to *monumentalize* a particular phenomenon of that day when it was being built, and of that day only."

In accordance with this testimony (based on astronomical observations) is the argument in the article on Astronomy in the American Cyclopædia. The author says: "We may accept the conclusion relative to the position of the North Star of that period, so as to shine down that entrance-passage," and adds: "This would set the epoch about the year B. C. 2170." Then he adds farther: "It is a remarkable fact that, as Prof. Smyth points out, the Pleiades were at that time in a most peculiar position, well worthy of being *monumentally commemorated*, for they were actually at the commencing point of all right ascensions, or at the very beginning of running that great round of stellar chronological mensuration * * * * which has been called elsewhere, for reasons derived from far other studies than anything hitherto connected with the Pyramid, the Great Year of the Pleiades."

Not only is this theory supported by the opinions of very eminent astronomers, but it is ascertained to be oriented wonderfully correct, more so than some of the most celebrated astronomical observations of modern times. It is admitted that it would have been utterly impossible to have both dated and oriented it so exactly without taking advantage of the most peculiar and exceedingly rare coincidences in star-pointings which occurred B. C. 2170, and at no other time within the round of the cycle of 25,827 years.

We do not mean to say that there have never been two stars, one exactly north and the other exactly south, one near the Pole and the other near the Equator, at any other time coincidentally; but we do say that there have never been two stars, for more than 25,000 years, thus situated at the same time, while the one at the north was exactly 3° 42′ from the Pole, which (it is admitted) must have been the case when the entrance-passage of the Pyramid was constructed,

XUM

so as to point not only exactly north, but also at the exact elevation of 3° 42′ below the Pole, when Thuban was situated at that point.

That wonderful entrance-passage, studied astronomically, explains clearly one phase of the object of that huge structure's erection. Directed to the North Star, when it was on the meridian and exactly 3° 42′ below the Pole, coincidently with the commencement of a Grand Cycle, it clinches the argument determining the date astronomically. That entrance-passage, if it had been pointed to the North Star at any other date, would have inclined more or less than it did, according to the distance of said North Star from the Pole. If it were pointed now to the same star, it would incline so as to aim, not at 3° 42′ below the Pole, but to a point *seven times* that distance from the Pole.

But the question may be asked, Might not a North Star alone be sufficient for the purposes intended in the erection of the Great Pyramid? We answer, a North Star alone might possibly be sufficient as a guide to approximate orientation, without reference to chronology. But a North Star, so near the Pole, has too small a circuit around the Pole, and moves too slowly to mark sidereal time. It would be like counting the revolutions of a large wheel on its extremely small hub instead of on its rim. To mark time accurately, the assistance is needed of an equatorial star, moving over a much larger circle and with much greater velocity. The two stars, one at the Pole and the other at the Equator, were essential to both orienting and dating the structure. Hence the conclusion that the Great Pyramid could not have accomplished its design as a monumental witnessing pillar at any other time, and that the only time when the aid indispensable was possible was B. C. 2170.

Richard A. Proctor, the peer of Herschel and Smyth as an astronomer, but an unbeliever in the inspiration theory as connected with the building of the Pyramid, says there was one other time when it would have been possible to orient it as they did. This was B. C. 3440, when the star Thuban (Alpha Draconis) was moving toward the Pole, as it was B. C. 2170 from it. He regards the founding of the Great Pyramid as "practically certain" on one of these tw epochs, thus disposing of all the estimates of all the different schools of chronologists put together with the sweeping declaration that, ' Gentlemen scientists, your suppositions are not within the limits of possibilities!" Very candidly for a sharp critic, however, while he claims that the Pyramid could have been oriented at either of these dates, he admits that it could not possibly have been both oriented and dated only at the later time of B. C. 2170. He says there is "a degree of accuracy rendering it practically certain that some stellar method was used in orienting the base." But as if unfavorable to the earlier date, he remarks of the North Star (towards which the entrance-passage pointed B. C. 3440): "It could not have been intended to be used for observing meridian transits of the stars in order to determine sidereal time." The aid of the other star, South, on the zodiacal belt, in connection with the one 3° 42′ below the Pole, toward which the entrance-passage pointed, was essential to making the date of the Pyramid simultaneously with its orientation. These two scientific performances were pos-

XUM

sible only at the later date, B. C., 2170. So, admitting all that this eminent critic claims with regard to the epoch as being hypothetical, as between two dates, the preponderance is overwhelmingly in favor of the later one.

All that can be brought to bear in favor of the earlier date is the bare possibility that the structure could have been sidereally oriented at that date. But that it was then oriented is not supported by any concurrent testimony whatever, either by historians or scientists, nor would it have been possible to have performed the more important scientific work of recording its date ("in some stellar method") on that occasion. Whereas the later epoch has in its favor the concurrent testimony of historians in general till the beginning of the present century, together with the opinions of very eminent astronomers; the evident design in its erection, to establish a standard of measures (which, to be perfect, must include a starting point from which to measure time), its own independent symbolical scale of time measures, and its harmony with the Bible, not merely in tracing the origin of the Egyptians, but in marking age.

That this date, B. C., 2170, is in harmony with accredited history at the close of the last century accords with the well-known pithy language of Napoleon at the battle of the Pyramids when his army, all footmen, were attacked by the splendidly equipped Mameluke cavalry. They formed in hollow squares, with cannon at each corner, and, as they mowed down the enemy, Napoleon cried out to his army, (as he pointed to the Pyramids): "Soldiers! Forty centuries look down upon you!" After this commenced the lengthening of dates, not only prehistoric, but to well-attested historical occurrences, including the date of the structure which is the subject of this discussion.

It is a singular fact that the mania for date-stretching (within the historic period) increased in extravagance among chronologists about in proportion to the degree of their skepticism on divine revelation. But we will call them to the witness-stand and let them testify for themselves.

The French chronologists (or, more properly speaking, date-stretchers) under the lead of Renan, Lesuere and Marriette place the epoch of the Great Pyramid at about B. C. 4956, or nearly 5,000 years before the Christian era.

The Germans, under the lead of Lepsius, Bunsen and others, place it nearly 2,000 years later, at about B. C. 3124. The English, under the lead of Rawlinson, Wilkinson and Lane, place it between 600 and 700 years later than the Germans, at about B. C. 2440.

Osborne, a very reliable English Egyptologist, more especially from a religious stand-point, places it at about B. C. 2228, or within a half century of the date as determined by astronomical calculations. Here is a divergence among highly educated men of science of 2,728 years in the date of a structure built within the historic period. And this is the boasted result of modern scientific research, aided by keys to hieroglyphics and translations of the most ancient languages and the most renowned academies of science in the world. And this wide diversity of opinion relates to the age of man's works, not only within the

XUM

historic period, but to works of man still standing in almost as perfect a conditoin as when they were made.

Now, what are we to infer from this discordance of scientists on a subject so important? If it were submitted to them all jointly as a jury, to determine, from all the evidence they have been enabled to obtain, when was the Great Pyramid founded? Their verdict probably would be "*not agreed.*" But there is no disagreement of this kind among that class of scholars, who determine its date astronomically, even though they differ widely in their religious views. Then, too, the astronomical determination harmonizes not only with history, but to the fraction of an inch with its own testimony, recorded in another manner entirely independent of this, on its own symbolical scale of time measures.

Farther, a monument embodying perfect science (then unborn, so far as we know), especially all kinds of measures, would betray more imperfection in its founder in omitting to mark its epoch (when such a mark was possible) than it would in omitting to *orient* it. Both performances would be of a highly scientific character; but the dating of the structure would be the more important of the two, as it would enable people in the distant future to know what, we now see, cannot be known without it, and to measure time accurately, as it would be impossible to measure it without the stellar aid furnished by the Great Pyramid's record.

So, we see here, this wonderful witnessing pillar is not merely abreast of scientists on chronology, but it is very far ahead of them; it annihilates at one sweep all the theories of all the long date, and short date, and intermediate date schools of chronologists (whether infidel or Christian) based on any other than the true astronomical basis. It becomes the one final arbiter to adjust all conflicting estimates, from whatever source, within the whole historic period of more than 4,000 years, and especially with regard to its own proper place, in a true chronological scale of time past.

Then, again, it is not without significance that its uniform harmonious correspondence with Bible teachings would lead one to expect that it would very carefully record its age. The foot-prints of old Chronology "on the sands of time," which he made during the fourth Egyptian dynasty over 4,000 years ago, are to-day, distinctly visible at the Great Pyramid. His tracks in those rocks are as perceptible now as when freshly made, and Mr. Astronomer, as clerk upon that occasion, has made a record of that date, which will stand till Thuban and Alcyone are blotted out of the heavens.

If it expands our ideas and conceptions to think of 25,827 years compressed into one *Great Year*, as though it were only one round of seasons, as viewed by celestial beings with bated breath—hear us, while we look up yonder, and our eyes pierce through the azure vault, to where "the heavens declare the glory of God, and the firmament showeth his handiwork," and then view with us on the great clock of the ages (called Job's day Mazzaroth), how principalities and powers in heavenly places take note of time as it passes, and regard that whole long period as only one day.

XUM

Forty and a-half centuries ago from the vernal equinox of next year, while everything was transpiring as usual among the idolators of Egypt, who were then at the height of their power and grandeur, that great clock struck the closing hour of an astronomical day. Suddenly at that instant there appeared a shepherd of great influence before King Cheops, whose name in the Egyptian language was Philitis, supposed to be from the country on the border of Canaan, afterwards occupied by the Philistines. Perhaps he was the same shepherd whose influence and power and wealth had been so conspicuous in Uz, and who was the richest as well as the best and purest of men in all the East.

The shepherd Philitis had such influence over King Cheops that he seems to have done by him as a later Pharaoh did by Joseph, "made him ruler over all that he had."

Then the founding of this immense structure (never exceeded in magnitude and the perfection of its plans) commenced, and for the time, in honor of the God of Philitis, all idol temples were closed and the offerings of idol sacrifices ceased, and idol-worship was suspended till this structure was completed. (See Herodotus.)

In looking at Mazzaroth now we see it is not quite IV o'clock, sidereal time. So a little less than four hours of celestial time have passed since that event occurred.

That Job was acquainted with the region of the Great Pyramid, hear what he says about where he would have lain, unmolested, had he perished "as an untimely birth." He says: "Then had I been at rest among kings and counselors of the earth which built desolate places for themselves, or with princes that had gold, who filled their houses with silver." (Job, iii, 13-15.)

Rev. Philip Schaff, D. D., says: "The Bible, as far as I know, alludes but once to the Pyramids." He thinks its allusion here unmistakable, and that the "desolate places" referred to (verse 14) were either the Pyramids themselves or the mausoleums around them, where kings and legislators were entombed.

When the two guiding stars, Alcyone and Thuban, one on the long circle on the Equator and the other on the short one at the Pole, shall, like the hands of a clock, have completed one round on their dial-plate, that is, when they shall have completed their cycle of over twenty thousand more years, where shall we be if immortal? What think you will then be the condition this terrestrial globe?

When Chronology himself shall have grown old and decrepit, and the mighty angel of Apocalypse "shall stand one foot on sea and one on solid land, and swear by him who liveth forever and ever, that time shall be no longer," the material which composes this earth, though changed, will still remain, and its Author and Proprietor will be no more effected by it than we shall be in changing a brush heap into a fertilizer for our garden. Such an event will require no greater changes on the earth during the present Great Year than have occurred during the past.

How will the anniversary of the Great Year of the Pleiades be celebrated?

and who will be witnesses on that occasion? are questions entirely beyond the grasp of our conceptions.

> Chronology looks back to when a child,
> But scarce remembers when these rocks were piled,
> Or chambers laid. But with amazed eye,
> He seems to pause with other passers by,
> And wonder how the knowledge now made known,
> Was put in symbols here, ere books were born."*

*A parody.

MEDICINE AND HYGINE.

VALUE OF ANOINTING IN INFANTILE DISORDERS.

BY H. GUARD KNAGGS, M. D., F. L. S.

During the past eleven months I have been testing, with uniformly successful results, the value of a very simple method of treating such infantile complaints as atrophy, bronchitis, convulsions, diarrhœa, febrile disturbances generally, and indeed all disorders of childhood which are accompanied by an unnatural state of the skin.

The treatment simply consists in smearing with salad oil the whole surface of the body, from the crown of the head to the tips of the fingers and toes, the process being repeated every twelve, six, or even four hours, according to the urgency of the case. Of course, the use of a long flannel gown or small blanket is obvious, and the fluid should be slightly warmed.

The application of oil possesses the following immense advantages over the ordinary warm bath :

1. Skin-action is more completely and permanently restored.

2. The danger of reaction is avoided, for there is no sudden change of temperature; and, moreover, the sheet of oil protects the surface from atmospheric influences.

3. It acts as a fuel-food, not only preventing waste of tissue, but actually increasing the bulk of the little patient.

4. It does not depress, but, on the contrary, appears to exhilarate.

It will scarcely be credited by many that the formidable affections above mentioned will frequently yield to this treatment, or, at any rate, show signs of abatement in from twenty minutes to four-and-twenty hours; but such is the case, though sometimes forty-eight or even seventy-two hours will elapse before any decided signs of improvement occur. By way of illustration, here are a few examples out of many, and I shall be happy to satisfy any gentleman as to their genuineness :

Atrophy.—My cousin, Mr. H. S. Knaggs, was called to see an infant, whom

he found apparently *in articulo mortis*. The mother informed him that she had sent for him "for satisfaction only." The child was oiled, and in twenty minutes began to look about and took its food. In the course of a fortnight it recovered its ordinary health and strength.

Several similar cases have come under my notice. One of them is rather amusing. A brother practitioner himself told me of, and gave me permission to publish, the following conversation. which took place between him and a parish patient: "Whose child is that?" "Why, mine, sir." "But surely not the child that I told you a week or two ago you would never rear?" "It is, though, sir." "Then the medicine seems to have set it to rights." "But it has had none of the medicine." "Then what have you been doing with the child?" "Why, sir, don't you recollect you told me that a friend of yours recommended that sick children should be rubbed all over with salad oil, and that I might try it if I liked, but that you had no faith in it? Well, sir, I did oil it, and the child has been improving ever since."

Bronchitis.—Last January a desperate case came under my care, which, in spite of active treatment, became rapidly worse. As a last resource I smeared it all over with salad oil, and, to my utter astonishment, there was a marked improvement in the breathing in less than twenty minutes. It a few hours the bronchitis entirely subsided.

Another case—double capillary bronchitis, neglected for several days—came under my relative's notice. He considered it too far gone for medicinal measures, and, therefore, ordered it to be oiled every four hours. The next day the symptoms had diminished in severity, and on the morning of the third day the child was sitting up in bed taking food, and to all appearances convalescent.

Convulsions.—In these cases the effect of oiling is sometimes truly surprising, the fit ceasing before the completion of the operation and not subsequently returning. A patient informs me that whenever she observes the symptoms which used to precede convulsions in her boy, she at once oils him, when a calm sleep follows, from which the child wakes up refreshed.

Diarrhœa.—Some time since my cousin had an uncontrollable case of diarrhœa under his care in a child of seventeen months. I advised him to give oil a trial; but he said it was too far gone for anything to be done. I saw the little sufferer myself a day or two afterwards, and ordered it to be oiled every six hours. There was a marked improvement immediately after the first application. By the next day the prostration was gone. Previous to this attack the child was a "puny little thing," but now (oiling three times a week having been persisted in up to the present time) it is "a splendid boy."

Enlarged Liver in a rickety child, with bronchitis supervening.—This case had been under the care of a well-known hospital physician, who gave it up, saying that nothing more could be done for it. I ordered it to be oiled every six hours. After each application a calm sleep followed. In about seventy-two hours the bronchitis began to give way, and a few days afterward the liver was observed to have diminished in size. The child has not since ailed.

Such is a sample of a few of the cases which have come under my notice. Did I not confine these notes to infantile disorders, a long string of other complaints, which are to be benefitted or cured by oiling, might be added. It seems as though the good old Greek and Roman practice will have to come up again. Such is progress!—*The Lancet, January 22, 1878*

ALUM IN BREAD.

Dr. W. A. Hammond, of New York City, expresses himself as perfectly certain of the injurious effects of alum, whether used alone to whiten bread or as an adulterant of baking powder. As to the claim advanced that the alum was neutralized and changed into an insoluble salt, he says that this was a wholly improbable assumption, since such a perfect change could not take place unless the amounts of the alum and the bicarbonate of soda were combined in the exact chemical ratio necessary for each to absorb all of the other. Not only was this impossible in the manufacture of large quantities of baking powder, but the homogeneous character of the compound could not be exactly maintained throughout the whole mass, and, therefore, there would be sure to be a certain amount of free alum in any bread made with an alum baking powder. But even if the exact proportion were maintained, the salts formed would retain their injurious properties, as they would be dissolved in the gastric juice. The gastric juice contained not only lactic acid, but a large amount of hydrochloric acid, and both the sulphate and hydrate of alumina would be dissolved. The phosphate might not be, but in that case the bread would be deprived one of its most desirable ingredients, making the use of alum not only dangerous to the stomach, but deteriorating to the food. The hydrate of alumina, Dr. Hammond says, would certainly be injurious to the mucous membrane. It would inevitably tend to constipate the bowels and interfere with digestion, and anything that tends to render the albumen of the bread insoluble, and therefore takes away its nutritive value, is injurious.

SCIENTIFIC MISCELLANY.

ANCIENT TENURES AND JOCULAR CUSTOMS.*

BY W. H. R. LYKINS, KANSAS CITY.

For the amusement of the readers of the REVIEW, and more particularly those of them belonging to the legal fraternity, I have spent some of the leisure time afforded me by a recent confinement to the house in collating the following

*_Fragmenta Antiquitatis_, or Antient Tenures of Lands and Jocular Customs of some Manors: By James Blount, of the Inner Temple, Esq., 1679.

items of old English law and custom, from a work written in 1679 and now so rare that probably there are not more than three copies in the United States. The author, Mr. Blount, was quite a prolific writer, having published, among other works: *The Academy of Eloquence, containing a compleat English Rhetoric*, Printed at London in the Time of the Rebellion, and several Times after; *Glossographia*, or a Dictionary interpreting such hard Words, whether Hebrew, Greek, Latin, Italian, &c., that are now used in our refined English Tongue, &c., London, 1656; *The Lamps of the Law and the Lights of the Gospel.* London, 1658. Written in Imitation of J. Birkenhead's *Paul's Church-yard*, and published under the Name of *Grass and Hay withers; Booker Rebuked*, or Animadversions on Booker's *Telescopium Uranicum* or *Ephemeris*, 1665, which is very erroneous; Quarto in one Sheet, which made much Sport among People, &c., &c.

The work is divided into four heads, viz.: Of Grand Serjeanty; Of Petit Serjeanty; Of Lands held of Subjects by Services, &c.; Of Customs of Manors, Antient modes of Tryal and Punishments, Antient forms of Grants, &c.

Among the Grand Serjeanties, by which the nobility of England acquired, and their assistants retain, their estates, were those of assisting at the coronation of kings and queens, the celebration of their birthdays, personal attendance in times of war, etc. Thus, among the services rendered by the Lord Great Chamberlain of England, and for which he received a magnificent compensation in lands and titles, were the following:

"To him belongs *Livery* and *Lodging* in the King's Court and certain *fees* due from each *Archbishop* and *Bishop* when they do *Fealty* and *Homage* to the *King*, and from all the *Peers* of the Realm at their *Creation*, or when they do *Homage* or *Fealty;* and at the *Coronation* of every King he is to have *forty ells* of *Crimson Velvet* for his own *Robes;* and on *Coronation Day*, before the King rises, he is to bring his *Shirt*, *Coif* and *wearing clothes*, and, after the King is by him apparelled and gone forth, to have his *Bed* and all the *Furniture* of his *Bed-Chamber* for his *Fees*, and all the King's Night apparel, and to carry at the *Coronation* the *Coif*, *Gloves* and *Linen* to be used by the King upon that Occasion; also the *Sword* and *Scabbard* and the *Gold* to be *offered* by the *King*, and *Robe-Royal* and *Crown*, and to *undress* and *attire* the *King* with the *Robes-Royal*, and to serve the King that Day with *Water* to *wash* his *Hands*, and to have the *Bason* and *Towels* for his *Fees*," etc.

The clergy also came in for a full share of the distinctions and emoluments due for their services: The Dean and Chapter of Westminster claiming, at the coronation of King James II., "to instruct the *King* in the *Rites* and *Ceremonies* used at the coronation; to assist the *Archbishop* in Divine service; to have the custody of the *Coronation Robes;* to have *Robes* for the *Dean* and his three *Chaplains* and for sixteen *Ministers* of the said church, the *Royal Habits* put off in the church, the several *Oblations*, *Furniture* of the *Church*, *Canopy*, *Staves* and *Bells*, and the *Cloth* on which their Majesties walk from the west door of the church to the theater," &c.

Peter Picot held the half of Heydine by the serjeanty of serving with a towel

at the coronation of the king, and Peter, the son of the above, held the other moiety by the serjeanty of serving with the basin.

Robert Agyllon held one carucate of land in Surrey by the service of making one "Mess in an Earthern Pot in the Royal Kitchen, the said mess to be called *Diligrout*, and if there was Fat or Lard in it, it is called *Maupigurnum.*" This mess was made, presented and served to Charles II., who accepted the service, "*but did not eat of the Pottage.*" But we greatly fear that if any of the family were called upon at the present day to prepare Diligrout, they would make a "mess" of it indeed, for in Knight's Pictorial History of England we are told that the recipe is now lost.

Robert de Marmion, the well-known Lord

"————of Fontenaye,
Of Lutherwood and Scrivelbaye,
Of Tamworth tower and town,"

held his possessions by the service of hereditary Champion to the King, an office which his ancestors had held, before the days of the Conqueror, to the Duke of Normandy.

Solomon de Campis (or At-field) held certain lands in Kent by the serjeanty of *holding the head* of the king in his sea voyages between Dover and Whitford.

John de Warbleton held the manor of Shirefield by the serjeanty of being Marshal of the Laundresses, and dismembering the condemned malefactors, and measuring the gallons and bushels in the king's household.

Roger Corbet, for the manor of Cheltington, in the county of Salop, was to follow his sovereign to the wars, bearing one bow and three arrows, with a "bacon," or salted hog, and to continue in service until he had eaten one-half of said hog. In case of great danger it may be presumed that Roger was expected to "go the whole hog."

Among the Petit Serjeanties were the furnishing men, horses, arms and equipments, etc., for the army in times of war; also, performing certain legal services, such as keeping the gaols, acting as sheriffs, bailiffs and marshals; also, rendering such services as "finding litter for the king's bed and hay for the king's palfrey," and furnishing clothing and food for the king and his household. John Campes held the manor of Finchingfield by the service of turning the spit at the coronation of Edward III. Thomas Winchard held land in Comingston by the service of saying daily five *Pater Nosters* and five *Ave Marias* for the souls of the king's progenitors, etc. Peter de Baldwyn held a certain serjeanty in Surrey by gathering wool for the queen from the white thorns, if he chose to do it; and if he refused, to pay twenty shillings a year instead.

In the Middle Ages the grotesque, the romantic and the warlike filtered their way through the most commonplace business transactions. Nowadays, to hold real estate, though an agreeable occupation, cannot on the whole be considered singular or peculiar. John Smith buys land, gets his papers, and henceforth his only difficulties are with tenants, taxes and other commonplace business transactions. Far different was it during the days of John's ancestors, when Johan de

Smythe held his *hyde* or *carucate* of land by the honorable service of the sword, or it may be he was *enfeoffed* of the hyde or carucate aforesaid on condition of finding the king in *gingerbread* (Paris piperatis), or of dancing a jig before the court on Christmas morning, or of some equally absurd act.

The conveyances of land were also grotesque and ludicrous. But for fear of occupying too much space, I conclude by quoting the rhyming grant made by William the Conqueror to "The Heyrs made of the Hopton, lawfully begotten:"

"To me and to mine, to thee and to thine,
While the water runs and the sun doth shine,
For lack of Heyrs to the King again,
I, William, King, the third Year of my reign,
Give to the Norman Hunter,
To me that art both Lone and Deare,
The Hoppe and Hoptown
And all the Bounds up and Downe,
Under the Earth to Helle,
Above the Earth to Heaven;
From me and from mine
To thee and to thine,
As good and as faire
As ever they mine were;
To witness that this is sooth,
I bite the White Wax with my Tooth
Before Jugg, Marode and Margery
And my Third Son, Henry,
For one Bow and one Broad Arrow,
When I come to hunt upon Farrow."

THE SILK INDUSTRY OF EUROPE.

The mother country of the present silk industry of Europe, says the *Textile Manufacturer*, is, without contradiction, Italy; the climate is specially adapted to the rearing of the silk-worm, and consequently the cultivation of silk has been carried on in that country for centuries, so that silk tissues are perhaps more used and cheaper there than—with the exception of Turkey—in any other continental state. The principal seats of the silk industry of Italy are Como, which alone has 7,000 looms, Turin, Genoa, Milan, Florence and Rome, in all of which towns hand looms are abundant. In fact, of the 20,000 looms running in Italy, only about 300 are power looms. There are only 25,000 fine spindles in the country, which tends to show that the silk industry is more of a domestic occupation than a factory one. Silk furniture damasks are manufactured at Turin, Vicenza, Navarra, and other places of minor importance.

From Italy the silk industry was transplanted about five centuries ago to France, and has there taken such root as to have become one of the chief industries of the country. The center of manufacture, formerly in Touraine, has now fixed itself at Lyons. Silk throwing and spinning is carried on in about 500 large or small establishments, occupying 70,000 hands. Silk waste, an important article

when so much is spun, gives employment to fifteen establishments, with 75,000 spindles, the waste being supplied by damaged or badly-reeled cocoons by the processes of combing, throwing, etc. Silk weaving is principally carried on at Lyons, supported by a large country district; also at Tours and Nismes. St. Etienne is the seat of the ribbon manufacture. Mixed goods of silk with wool or cotton are produced ot Paris, Roubaix and in Picardy. The total production of silk goods in France is estimated at £22,000,000 per annum, and the principal export is now to Great Britain, though formerly America took the largest portion until the United States raised their tariff to an almost prohibitive height. With the exception of the greater utilization of waste in the production of useful yarn, little progress or change has been made in the manufacture; even power looms are only used to a limited extent.

SEASONABLE HINTS FOR FLORISTS.

With March almost any flower-seeds may be sown. Choose a time when the surface is a little dry and the earth will powder under a slight blow. Sow the seeds shallow, barely covering them, but beating the dryish earth firmly after sowing.

Divide herbaceous plants when required; this work cannot be done too early. If delayed till after the plants have grown into leaf, the flowering will be very weak.

Plant trees and shrubs as soon as the earth is a little dry. Ram the earth tightly about the roots. Few do this work well, and more trees die from loosely filled in earth than from any other cause. Trees never need water at transplanting if the earth is rammed in tight enough. If the roots have been injured in digging, or the branches or roots are somewhat dry, prune the branches accordingly. Fibrous-rooted trees suffer more from drying than those with a few coarse roots.

In laying out new places of small extent, be careful of aping "principles of landscape gardening" that are only applicable to places of large extent. Remember that everything we do should have a meaning, and that this meaning as often depends on the time and circumstances as on any real existence in the principles themselves. It will be a failure to attempt to make a two-hundred-foot square lot look like a "country place." It is better to make the gardening border a little on the artificial. In this, terraces, vases and architectural objects will afford much assistance; and neatness, polish and finish generally be more pleasing than the sober negligence that should characterize a more quiet and extensive natural scene.

Shrubs are not near enough employed in planting small places. By a judicious selection, a place may be had in a blooming state all the year; and they, besides, give it a greater interest by their variety than is obtained by the too frequent error of filling it up with but two or three forest trees of gigantic growth. Plant thickly at first, to give the place a finished appearance, and thin out as they

grow older. Masses of shrubs have a fine effect on a small place. The center of such masses should be filled with evergreen shrubs, to prevent a too naked appearance in the winter season.

Ornamental hedges judiciously introduced into a small place add greatly to its interest. No easier method offers whereby to make two acres of garden out of one in the surveyor's draught. The Arbor Vitæ, Chinese and American Hemlock, Holly, Beech, Hornbeam, Pyrus Japonica, Privet, and Buckthorn may be applied to this purpose.

It is well to again remind the reader of what we said last month; not to lay out too much work for the year, but to see that what is planned is executed tastefully and well. The true art of gardening does not consist so much of having everything on one's ground as in the combinations. One thing should be made to help the other. The garden should not be merely a collection of all sorts of things like a museum, but the collection should form one delightful garden. Even plants that are weeds in some situations can be made very effective in the make-up of a garden.—*Gardener's Monthly.*

To reach the ore in the Leadville mines it is necessary to pass through from twenty to sixty feet of regular wash gravel, containing bowlders from the size of a man's fist to a ton's weight. After this comes a formation of what is called porphyry, but which is said not to be porphyry at all. It is a white substance containing mica, and which, in the Winnemucca mine, is sixty or seventy feet thick. When first this is encountered it is hard, but next to the ore vein it is soft, and is called "Chinese wax." This is a pliable white clay of the same constituents as the harder formation, but more disintegrated. Then comes the ore vein, from two to thirty feet in thickness. The ore is a carbonate, very similar to that of the Base Range at Eureka. It has some knots of galena in it. Under this ore is a formation of ironstone, and this in turn rests on limestone.

EDITORIAL NOTES.

THIS number completes the second volume of the REVIEW, and, in closing, we do not know that we can do better than to repeat what we said a year ago—that upon looking over our work we are tolerably well satisfied with it. Our effort at all times has been to make the REVIEW an acceptable visitor to all classes of readers, and with this view we have been compelled to procure our articles from a large number of sources. Fortunately our contributors have used their talents upon diverse subjects, and our exchanges comprise periodicals, both English and American, devoted to almost every branch of science, so that our task has been comparatively easy after all.

A reference to the copious index accompanying this number will show that a surprisingly large number of popular and technical subjects have been treated this year.

It is a matter of pride to us that so many of the distinguished scientific men of the country have deemed the REVIEW a suitable medium for placing their ideas, theories, records and discoveries before the reading public, and we have assurances that there

will be no falling off in this respect in the future.

We have given our readers 768 pages of well-printed, substantial and reliable reading matter, comprising original articles by more than thirty able writers, and selected from a list of over fifty of the best scientific, medical, educational, agricultural and literary periodicals in the world, and have distributed for our advertisers 12,000 copies of the REVIEW in more than half of the states of the Union, but principally in Missouri, Kansas andColorado, where it has reached not less than four or five times as many readers.

The REVIEW has been warmly welcomed, and many of its articles copied by the press of this country and England, both scientific and literary, and has been quite as well patronized, especially in Kansas City, as could possibly have been expected, considering that it is the first publication of the kind which has ever been started in the West. Another year we shall hope to improve it in several respects; however, still further attempting to adapt it to the popular rather than to the strictly scientific taste. We shall also hope for an increased support, both at home and at a distance; at least sufficient to maintain it.

AT the February meeting of the Kansas City Academy of Science, Hon. R. T. Van Horn read the principal paper of the evening, entitled, "Life and Life Theories," which was an able and exhaustive review of the whole subject from the respective rtandpoints of the evolutionists and the advocates of creation, closing with some modestly expressed theories of the writer, which were, as was the whole essay, received with warm approbation. The paper will be found in full in this number of the REVIEW and will repay the reader abundantly.

Professor Parker's remarks on the connection or sympathy between the barometer and the magnetic needle will also be found in this number. At the next meeting of the Academy Dr. Fee will read an article upon Philology.

THE commencement exercises of the Kansas City College fo Physicians and Surgeons, on March 4th, were more than usually interesting. The addresses by Professors Taylor and Todd, and the remarks of President Thacher were appropriate and exceedingly well received; but the feature of the evening was the admirable address of Rev. Dr. Roberts, on "The Relations of Superstition, Skepticism and Faith to the Progress of Science," which will be found in this number of the REVIEW. The success of this medical school is very gratifying to its friends, and it is a credit to the West.

HON. E. H. ALLEN, of this city, recently delivered an address at the Kansas University, Lawrence, Kansas, which, according to the comments of the various literary and secular papers of the city, was fully up to his high standard in ability and eloquence.

THE *London Quarterly Journal of Science* (now monthly) copies the latter portion of Mr. Ermine Case's article on ornithology in the November *Review*, under the head of "Reason or Instinct?" while, in the same month, the *London Literary and Scientific Review* copied the first half of it under the head of "Peculiarities of Western Ornithology."

The article on "Peruvian Antiquities," by Dr. Heath, and the "Pyramid" papers, by Rev. James French, and many others, have also been widely copied, showing that the REVIEW is not without readers in the East as well as the West, and also across the Atlantic.

ALL subscribers who have lost or missed any numbers of the first or second volume can have them supplied *gratis* by the editor, and they can also have either or both years' numbers handsomely bound in half morocco and cloth sides *for* $1.00 *per volume.*

OUR former fellow-citizen, General Bingham recently prepared a lecture on "Art; the Ideal of Art and the Utility of Art," which was read at Columbia, Mo., March 1st, by Major Rollins (on account of the author's illness), and received the warmest commendations of the local papers.

We have received all the current magazines and periodicals, as usual, besides numerous valuable books, magazines and pamphlets, but our columns are so full, in closing the volume, that we are compelled to omit the notices they deserve for this time.

The Review has been regularly sent to several friends during the past year without first obtaining their consent, owing to the fact that the editor is fully occupied with his regular business during the day and can devote himself to editorial work evenings only, and consequently has had no time or opportunity to canvass for subscribers. It is hoped, however, that all such have been well enough pleased with the Review, not only to pay for it, but to continue to read it in the future.

PREMIUMS TO SUBSCRIBERS.

We have determined to adopt a new, and, as we think, appropriate and acceptable plan for giving premiums to our subscribers, viz:

To any person who sends us $3.50, we will send the Review for one year and any $1.50 book published by D. Appleton & Co., S. C. Griggs & Co. Robert Clarke & Co., Houghton, Osgood & Co., Roberts Bros., or J. B. Lippincott & Co.

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Back Numbers.—To any subscribers for the coming year we will furnish the back numbers of the first and second year for $2.25 each set, bound, or $1.25 each unbound.

The Review numbers among its contributors some of the most earnest and capable workers and thinkers in the West, viz.:

Prof. G. C. Broadhead, late State Geologist of Mo.
Prof. B. F. Mudge, late State Geologist of Kansas.
Prof. G. C. Swallow, of the University of Missouri.
Prof. F. H. Snow, of the University of Kansas.
Prof. E. A. Popenoe, Topeka, Kansas.
Prof. W. K. Kedzie, late of the Agricultural College of Kansas.
Col. Henry Inman, Larned, Kansas.
Prof. E. L. Berthoud, Colorado School of Mines.
Prof. Arthur Lakes, " " "
Rev. James French, Denver, Colorado.
Prof. C. W. Pritchett, of the Morrison Observatory.
Prof. A. J. Conant, St. Louis, Missouri.
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Prof. George Halley, M. D., " "
Prof. C. E. Crosby, " "
Rev. J. G. Roberts, D. D. " "
J. V. C. Karnes, " "
H. P. Child, Esq., " "
Ermine Case, Jr., " "
Edwin R. Weeks, " "

Of Eastern Scientists who have, during the past year contributed to the Review, we may mention Prof. H. C. Bolton, Trinity College, Hartford, Conn.; Prof. C. V. Riley, Washington, D. C.; Capt. H. W. Howgate, U. S. A.; Isaac P. Noyes, of Rhode Island and Prof. O. T. Mason, Columbian College; Prof. John Rae, F. G. S., London, England, etc., etc.

The Western Review of Science and Industry, published at Kansas City, Mo., is one of the ablest publications of the kind in the West, and is always full to overflowing of valuable articles on all the leading scientific topics of the day. Its articles in one number alone are worth twice the subscription price. —*North Topeka Times.*

XUM

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The Leading Wheat State in the Union in 1878, and The Fourth Corn State—The Great Kansas Harvest of 1878 was Solid for the "Golden Belt,"

The celebrated Grain Belt of country, in the limestone section of Central Kansas, traversed by the Kansas Pacific.

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WHEAT! Kansas rises from the Eleventh Wheat State in 1877 to the **First Wheat State in the Union in 1878,** producing **26,518,958** bushels **winter wheat,** and **5,796,403** bushels **spring wheat;** total,

32,315,361

Bushels Wheat, **with only one-eighth of the State under cultivation.** The organized counties lying in the Golden Wheat Belt of the Kansas Pacific produced **13,335,324** bushels, or over **41** per cent, and, including unreporting counties, fully **14,000,000** bushels, or **45 per cent of the entire yield of Wheat in the State,** averaging 24 bushels to the acre, while the average for the State was 17 bushels per acre.

CORN! Kansas, the Fourth Corn State in the Union in 1878, produced **89,324,971** bushels of Corn. Of which the Golden Grain Belt counties produced **27,399,055** bushels, or **31** per cent, nearly one-third, of the entire yield of the State, with an equally grand showing in all other departments of agriculture.

The foregoing facts show conclusively why
29 per cent of the increase in population in the State during the *past four years;* and
40 per cent of the increase in population during the *past year;* and
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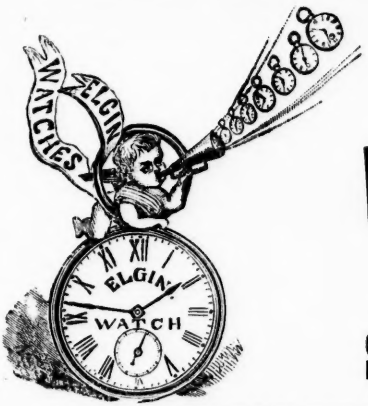

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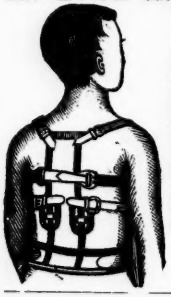

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